“A STUDY OF SERUM SODIUM LEVELS IN DECOMPENSATED CHRONIC LIVER DISEASE AND ITS CLINICAL SIGNIFICANCE”

A DISSERTATION SUBMITTED TO

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

In partial fulfillment of the regulations for the award of the degree of

M.D. GENERAL MEDICINE – BRANCH I

DEPARTMENT OF GENERAL MEDICINE

GOVERNMENT VELLORE MEDICAL COLLEGE AND HOSPITAL

THE TAMIL NADU DR.M.G.R MEDICAL UNIVERSITY

CHENNAI

APRIL 2016

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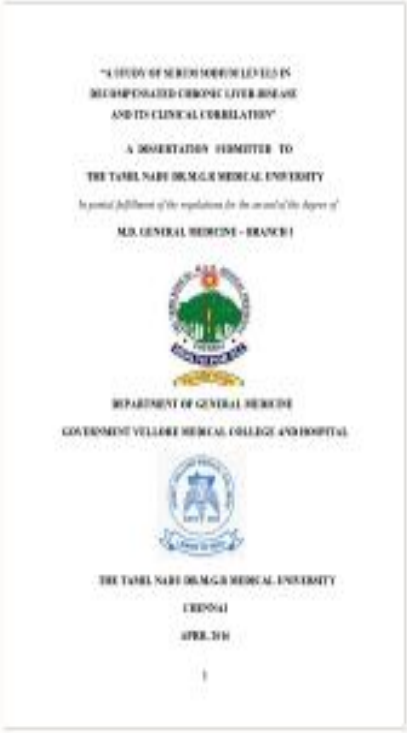

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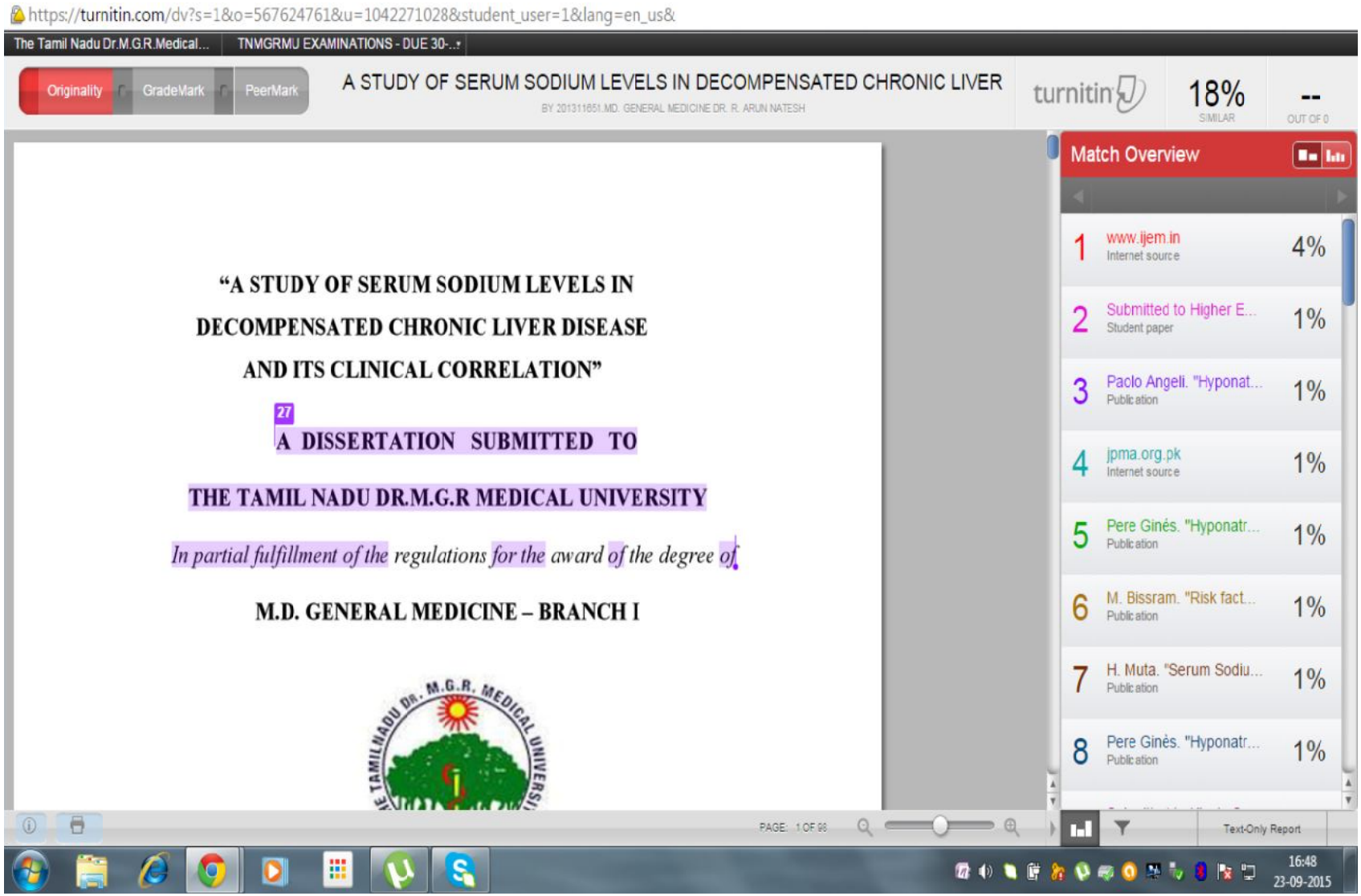
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LIST OF ABBREVIATIONS

1.	DCLD	DECOMPENSATED CHRONIC LIVER DISEASE
2.	UGI	UPPER GASTRO INTESTINAL
3.	MELD	MODEL FOR END STAGE LIVER DISEASE
4.	TBW	TOTAL BODY WATER
5.	ICF	INTRACELLULAR FLUID
6.	ECF	EXTRACELLULAR FLUID
7.	PCT	PROXIMAL CONVOLUTED TUBULE
8.	AVP	ARGININE VASOPRESSIN
9.	GFR	GLOMERULAR FILTRATION RATE
10.	OVLT	ORGANUM VASCULOSUM OF LAMINA TERMINALIS
11.	BP	BLOOD PRESSURE
12.	AQP	AQUAPORIN
13.	U_{Na}	URINE SODIUM
14.	EABV	EFFECTIVE ARTERIAL BLOOD VOLUME
15.	CHF	CONGESTIVE HEART FAILURE
16.	CKD	CHRONIC KIDNEY DISEASE
17.	SIADH	SYNDROME OF INAPPROPRIATE SECRETION OF ANTIDIURETIC HORMONE
18.	CNS	CENTRAL NERVOUS SYSTEM
19.	ISE	ION SPECIFIC ELECTRODE
20.	FENa	FRACTION EXCRETION OF SODIUM

21.	NaCl	SODIUM CHLORIDE
22.	CT	COMPUTED TOMOGRAPHY
23.	MRI	MAGNETIC RESONANCE IMAGING
24.	ACTH	ADRENOCORTICOTROPHIC HORMONE
25.	ODS	OSMOTIC DEMYELINATION SYNDROME
26.	DI	DIABETES INSIPIDUS
27.	ADH	ANTI DIURETIC HORMONE
28.	PH	PORTAL HYPERTENSION
29.	DH	DILUTIONAL HYPONATREMIA
30.	SBP	SPONTANEOUS BACTERIAL PERITIONITIS
31.	HRS	HEPATORENAL SYNDROME
32.	HE	HEPATIC ENCEPHALOPATHY
33.	PG	PROSTAGLANDIN
34.	CPS	CHILD PUGH SCORE
35.	PT	PROTHROMBIN
36.	INR	INTERNATIONAL NORMALIZED RATIO

ABSTRACT

Background:

Decompensated Chronic Liver Disease is associated with disturbances in regulation of water balance leading on to abnormalities in serum sodium. Various studies have established a correlation between serum sodium levels and survival in these patients. Dilutional Hyponatremia due to impaired free water clearance is the most common dysnatremia while hypernatremia due to cathartic use has also been reported in few studies. The aim of this study was to study the serum sodium levels in patients with DCLD and to establish its significance.

Methods:

Data were collected from 97 patients admitted in medical wards. Patients were divided into groups based on serum sodium levels and the relevant parameters analyzed among the groups.

Results:

Among 97 patients, 42 (43.30%)had serum sodium levels ≥136 mEq/L, while 32(32.99%)had serum sodium levels between 131 and 135 mEq/L. 23(23.71%) patients had serum sodium level ≤130. No patients had serum sodium levels greater than 145. Serum sodium levels was associated strongly with the severity of liver disease as assessed by Child Pugh and MELD score. Serum sodium ≤130 indicated the existence of Hepatic Encephalopathy (p

value <0.0001), Hepatorenal Syndrome(p value <0.0001) and Spontaneous Bacterial Peritonitis(p value <0.0001). Patients with serum sodium less than 130 mEq/L had increased frequency of complications than those with ≥136 mEq/L. Patient with serum sodium levels ≤130 had increased mortality(30.4%; p value- 0.002)

Conclusion:

Hyponatremia is more common in DCLD and low serum sodium levels are associated with increased frequency of complications such as hepatic encephalopathy, hepatorenal syndrome, spontaneous bacterial peritonitis and GI bleeding. Lower serum sodium levels were associated with increased MELD CPS score and mortality indicating the inverse relationship between serum sodium levels and severity of the disease.

Keywords: Hyponatremia, Hypernatremia, Decompensated Chronic Liver Disease.

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INTRODUCTION

The normal range of serum sodium is 135-145 mEq/L. Its homeostasis is vital to the functioning of the cell. An imbalance in the regulation of total body water can lead to abnormal sodium levels. Decompensated chronic liver disease(DCLD) is associated with disturbance in water homeostasis leading to dysnatremias. [1-7]

Hyponatremia is defined as concentration of sodium less than 135 mEq/L. It occurs when there is excess of water in relation to sodium. It is the most common electrolyte disorder in hospitalized patients and more so in DCLD patients.[6,7,8-15] A disturbance in total body water regulation leading to decreased clearance of solute free water and the consequent inability to match the urine output to the amount of water ingested leads to dilutional hyponatremia.

Hypernatremia is defined as concentration of sodium more than 145 mEq/L. It is associated with high mortality rate. Hypernatremia, though uncommon compared to hyponatremia in DCLD patients, occurs due to use of osmotic cathartics and Upper Gastro Intestinal (UGI) bleeding. If present, it is associated with increased mortality.[16]

Recent studies have reported that lower serum sodium levels were associated with increased complications and mortality leading to incorporation of sodium in the MELD score.[6,8,11,13-15] Hypernatremia when present is also associated with increased mortality. Therefore we undertook this study in our

tertiary hospital to study serum sodium levels in patients admitted with DCLD and to establish its significance.

AIMS AND OBJECTIVES

1. To study serum sodium levels in patients with Decompensated Chronic Liver Disease and establish its significance.

REVIEW OF LITERATURE

A substance that dissociates into ions and acquire the capacity to conduct electricity is defined as Electrolyte. In the body, Sodium, Potassium, Magnesium and Calcium are the cations while Bicarbonate, Chloride and Phosphate are the anions. These electrolytes are involved in the metabolic activities and are essential to the normal functioning of the cell.

The concentration of various electrolytes in the body fluid is maintained within a narrow range. However the optimal concentrations in the extracellular and intracellular fluid differ. For example the concentration of sodium in extracellular fluid is 15 times more than in the intracellular fluid. Conversely the concentration of potassium within the cells is 30 times more than that present in the extracellular fluid.[17]

COMPOSITION OF BODY FLUIDS:

The most abundant constituent in the body is water. It accounts for 50% of body weight in women and 60% in men. Water is distributed in two major compartments within the body. Total Body Water[TBW] is distributed as Intracellular Fluid [ICF] and Extracellular Fluid [ECF]. ICF constitutes 55-75% of TBW while ECF constitutes about 25-45%.(Figure 1) ECF is further divided into Interstitial (extravascular) and Plasma water (intravascular) in the ratio of 3:1as shown in Table 1. Starling Forces i.e., balance between the hydrostatic pressure gradient and the oncotic pressure, determines the movement of fluid

across capillary walls between these two compartments. Lymphatic flow redistributes the fluid back into the intravascular compartment.

TABLE 1: DISTRIBUTION OF FLUIDS FOR A 70 KG MAN		
COMPARTMENT	**VOLUME OF FLUID-40L**	**% OF TBW**
INTRACELLULAR	24L	60%
PLASMA	3.2L	8%
INTERSTITIAL FLUID	11.2L	28%
TRANSCELLULAR FLUID	1.6L	4%

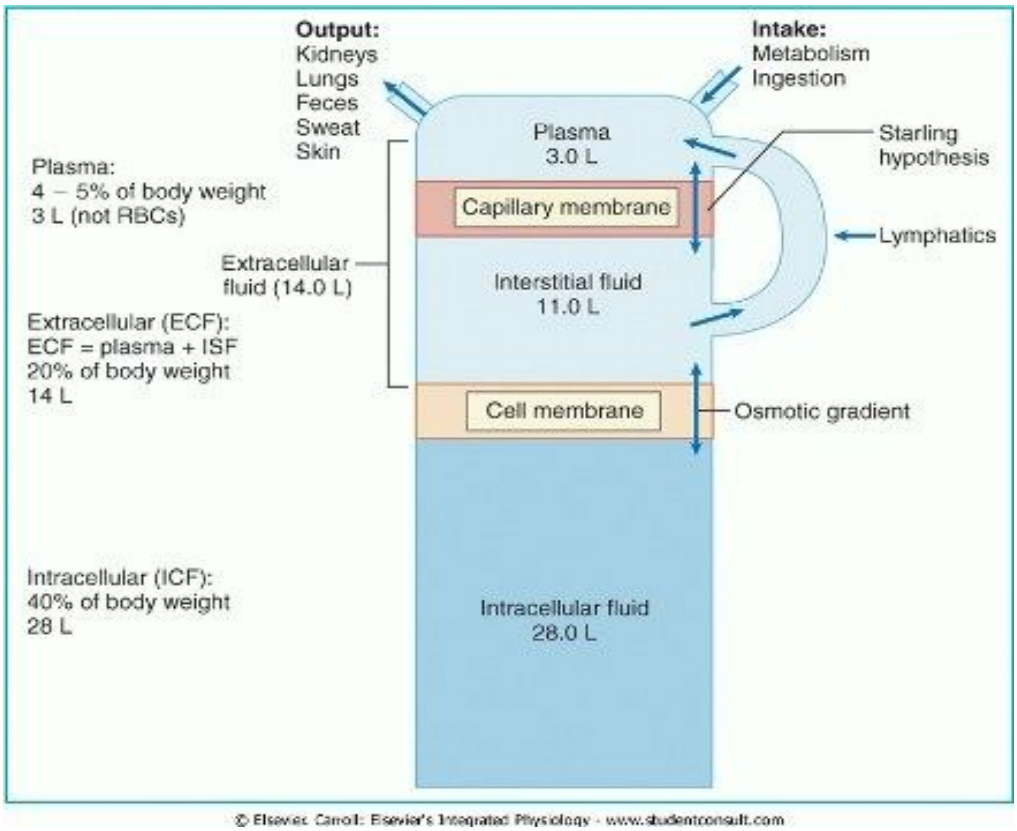


FIGURE 1: DISTRIBUTION OF TOTAL BODY WATER

Osmolality expressed as milliosmoles/kilogram(mOsm/Kg), is the concentration of all the solutes in a fluid whereas Tonicity denotes the concentration of "effective" solutes that causes shift of fluid across body fluid compartments. Sodium(Na^+) and its accompanying anions[chloride(Cl^-) and bicarbonate(HCO_3^-)] constitute the major ECF particles while Potassium(K^+) and organic phosphate esters (ATP, Phospholipid and Creatine Phosphate) form the major ICF osmoles. Solutes such as Urea do not cause shift of water across most membranes and are thus called as Ineffective Osmoles. The difference in composition of major solutes in ECF and ICF is illustrated in Table 2.

INTRACELLULAR(mEq/L)	SOLUTES	EXTRACELLULAR(mEq/L)
25	Na^+	140
150	K^+	4.5
2	Cl^-	100
6	HCO_3^-	25
15	Mg^+	1.2
0.01	Ca^{2+}	2.4
50	PO_4^{2-}	1.2

TABLE 2: COMPOSITION OF MAJOR SOLUTES IN ICF AND ECF.

SODIUM AND WATER HOMEOSTASIS:

The function and survival of each cell in the body depends on the maintenance of proper milieu. A key component to this maintenance of this milieu is the tonicity of ECF, which also acts as a significant determinant of composition of intracellular fluid. Most aspects of our physiology such as signalling pathways, neuronal depolarization, myocyte signalling etc., are dependent on the constancy of the ambient osmolarity.

Serum Sodium concentration is a single most important factor in determining the extracellular tonicity. It has to be tightly regulated for the normal functioning of the cell. Correspondingly, significant variation in concentration of serum sodium are tolerated poorly and causes cellular dysfunction. Though there are wide variations in intake of water, ingestion of solutes and non-urinary water loss, serum sodium is kept in a narrow range as a result of strict balance between water intake and water output. This strict balance is achieved through regulation of urinary tonicity.

Total Body Water content is tightly regulated by various mechanisms in the kidney such that changes in total body water match the changes in Na^+ and K^+. The regulation of water intake is determined by Thirst control and water excretion by urinary dilution and concentration. Dysnatremias are usually the result of abnormalities in water balance.

To understand the pathogenesis of dysnatremias with respect to water balance requires knowledge of both sides of water balance equation. The body loses about 1100ml of water per day via stools, respiratory tract surfaces and from the skin surface. In addition kidneys excrete some amount of water as part of clearance of solutes. An individual ingesting a standard diet should excrete 400 mOsm of electrolytes(sodium, potassium and their respective anions) and 500 mOsm of urea(100 mOsm from diet and 400 mOsm from protein ingestion).The maximum urinary concentration attained in a normal individual is 1200 mOsm. Therefore, a minimum of 750 mL water should be excreted by the kidneys for for the excretion of 900 mOsm of solutes.

TABLE 3: MODE OF WATER LOSS FROM THE BODY

MODE OF WATER LOSS	VOLUME
STOOL	200ML
EVAPORATION AT SKIN	500ML
RESPIRATORY TRACT SURFACES	400ML
KIDNEYS	750ML

Water ingested as liquids, taken as solid food and that produced as a result of metabolism comprise the intake side of water balance. Water consumed as solid food and produced from metabolism are fixed at 1200 ml, almost equal to that of fixed non-urinary losses. The remaining 650 ml of water should be ingested to equal the output of 1850 ml and stay in balance.

Water balance is easily maintained as long as the individual consumes this precise amount of water. However, the kidney can maintain this balance even when there is wide variation in the non renal water losses and intake. This is mainly attributed to the ability of the kidney to vary the concentration of urine depending on the abnormalities on either side of water balance.

If the total water ingested is more than that required for the excretion of solutes, the additional free water is excreted by dilution of urine. When an individual consuming normal amount of water develops increased loss of water

through diarrhea, increased sweating etc., the balance is maintained by the concentration of urine by the kidney and thirst stimulation.

DILUTING AND CONCENTRATING MECHANISMS OF NEPHRON:

Proximal Convoluted Tubule: (PCT)

Distal Nephron is responsible for tight control of water balance. Adequate tubular fluid must reach the distal segment for this tight regulation to occur. The proximal convoluted tubular epithelium is water permeable and 70% of the filtrate is reabsorbed isotonically, under normal conditions. The remaining 30% of filtrate that passes to loop of Henle is essential for the development of medullary interstitial tonicity gradient. The medullary tonicity gradient is essential for the overall maintenance of water balance. So, any decrease in the volume of fluid leaving the PCT and entering the loop of Henle will ultimately interfere with the control of water balance by altering the medullary tonicity gradient. This state of decreased delivery to distal segment occurs when glomerular filtration is reduced or the reabsorption in PCT is increased. This combination occurs in conditions causing volume depletion and poor renal perfusion.

The Loop of Henle:

Water is passively reabsorbed through the aquaporin-1 water channel in the descending limb of loop of Henle driven by the increased medullary

hypertonicity. This shift of water and variable solute addition results in the tubular filtrate reaching its peak osmolarity of 1200 mOsm/L as it enters the ascending limb. In the thin ascending limb, sodium reabsorption is passive while in the water impermeable thick ascending limb $Na^+/K^+/2Cl^-$ cotransporters aid in the reabsorption of sodium, potassium and chloride. This causes the tubular fluid to reach an osmolarity nadir of 100 mOsm/L, which enters the distal tubule.

The solute reabsorption and water impermeability in the ascending limb not only dilutes the tubular fluid but also generates a gradient of tonicity in the medulla, with higher tonicities in the deeper medulla. This medullary tonicity gradient is essential for the fine control of water balance exerted by AVP in the distal nephron. The medullary hypertonicity gradient not only depends on the adequate GFR and the amount of reabsorption at Proximal Convoluted Tubule but also on the upregulated blood flow in the vasa rectae at the Loop of Henle.

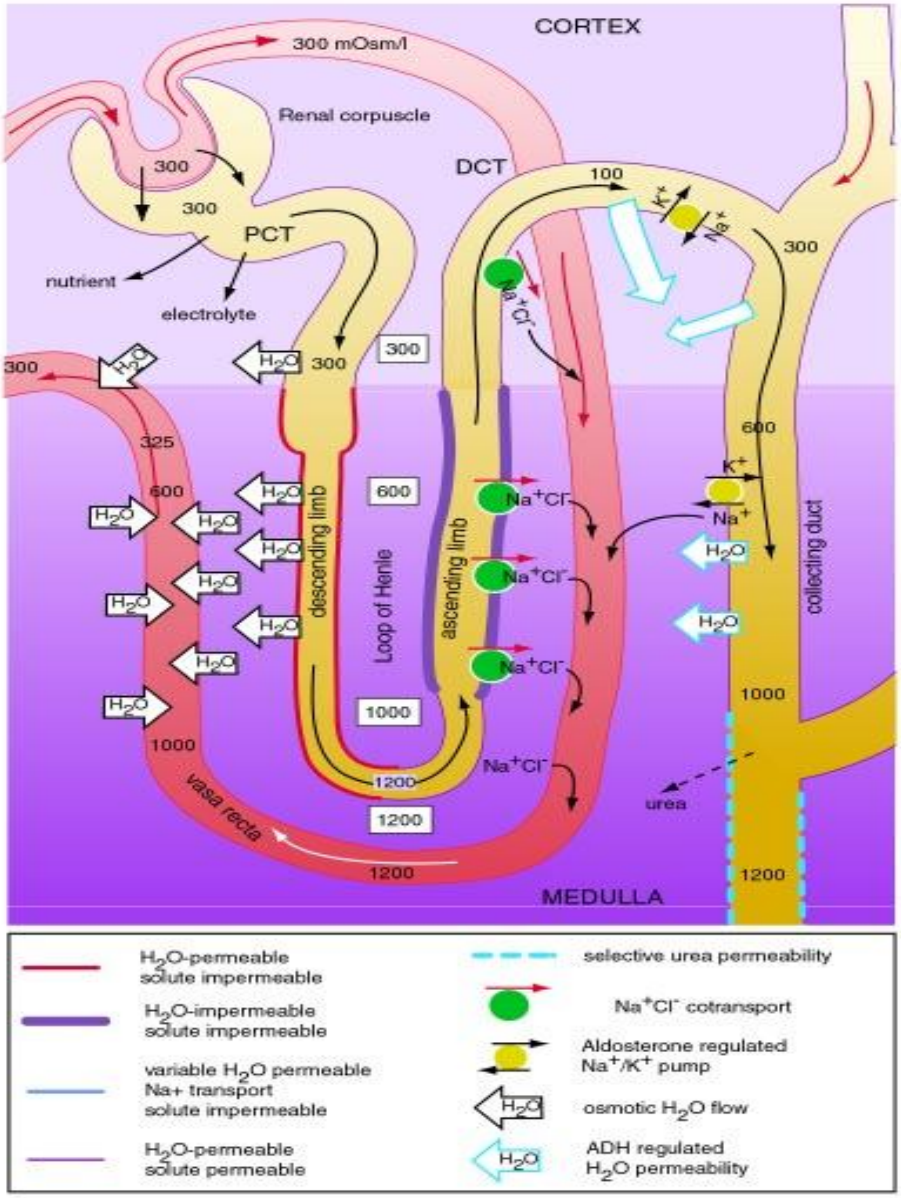


FIGURE 2: MECHANISM OF URINARY DILUTION

Distal Tubule and Collecting Duct:

The hypoosmotic fluid from loop of Henle reaches the collecting duct. The collecting duct descends through progressively increasing hypertonic medullary interstitium. The collecting duct is the region where fine control over water regulation is exerted. The important factor that determines the water

clearance and urine osmolarity at this point is Arginine Vasopressin(AVP). Knowledge about the action and regulation of AVP is important to understand the mechanism of water balance and the pathophysiology of dysnatremia.

ARGININE VASOPRESSIN: (AVP)

It is produced in the hypothalamus and gets stored as granules in the posterior pituitary. It is released in response to either osmotic or non-osmotic stimuli. The osmoreceptor cells in the Organum Vasculosum of the Lamina Terminalis(OVLT) and the subfornical organ mediates the osmotic trigger for AVP release. ECF osmolarity is sensed by these cells by way of cellular swelling and via their projections to anterior hypothalamus, they activate TRV4 channels which trigger AVP release. As little as 1% increase in ECF osmolarity is suffice to cause AVP release and 1% decrease in ECF osmolarity results in complete AVP suppression.

The relationship between serum sodium and serum osmolarity is well established. AVP levels are undetectable in plasma when serum sodium is below 135 mEq/L. When the levels reach 140 mEq/L AVP levels reach 5 pg/ml. AVP helps in maintaining serum osmolarity and serum sodium concentration within normal range. (Figure 3)

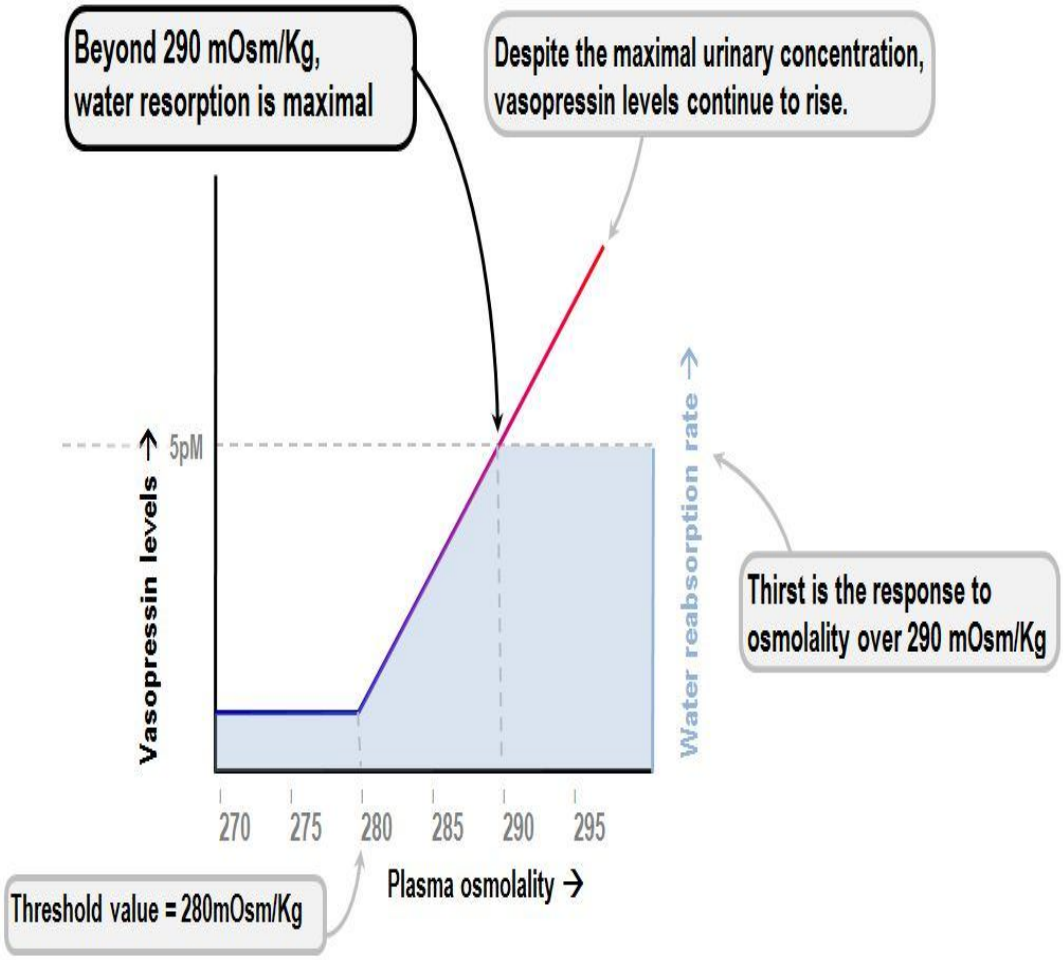


FIGURE 3: RELATIONSHIP BETWEEN OSMOLALITY AND VASOPRESSIN SECRETION

There are various non osmotic stimuli for AVP release. Most important among them are decreased intravascular volume or blood pressure(BP). Intravascular volume is detected by the venous baroreceptors in atria and arterial baroreceptors in carotid arteries and aorta. Together these receptors sense a decrease in intravascular volume and BP; sends afferent signals via Vagus and Glossopharyngeal nerves to stimulate AVP release. 7% decrease in intravascular volume is suffice to stimulate AVP release.

Since this stimulus is important in defense against circulatory collapse, it is stronger than the osmotic stimuli. Other non-osmotic stimuli include hypoglycemia, nausea, emotional stress and pain.

AVP ACTION ON KIDNEY:

The collecting duct is relatively water impermeable in the absence of AVP and will allow the hypotonic fluid to be excreted as dilute urine without significant tonicity changes. The presence of AVP will cause a dramatic change in the tonicity of urine.

V2 receptors are present on the basolateral membrane of collecting duct principal cells. AVP binds to these receptors and causes a translocation of Aquaporin 2(AQP2) water channels to the luminal membrane via cyclic AMP pathway[3]. This increases water permeability of collecting duct which causes passive water reabsorption along the concentration gradient into the hypertonic medullary interstitium. This action of AVP occurs within minutes and exerts control over short term regulation of water balance. When plasma AVP is elevated in a sustained manner, it causes increased expression of AQP2 and more AQP2 channels are available on the luminal side to allow maximal water permeability in the collecting duct. This long term regulation has implications in the hyponatremias that occur with edematous disorders.

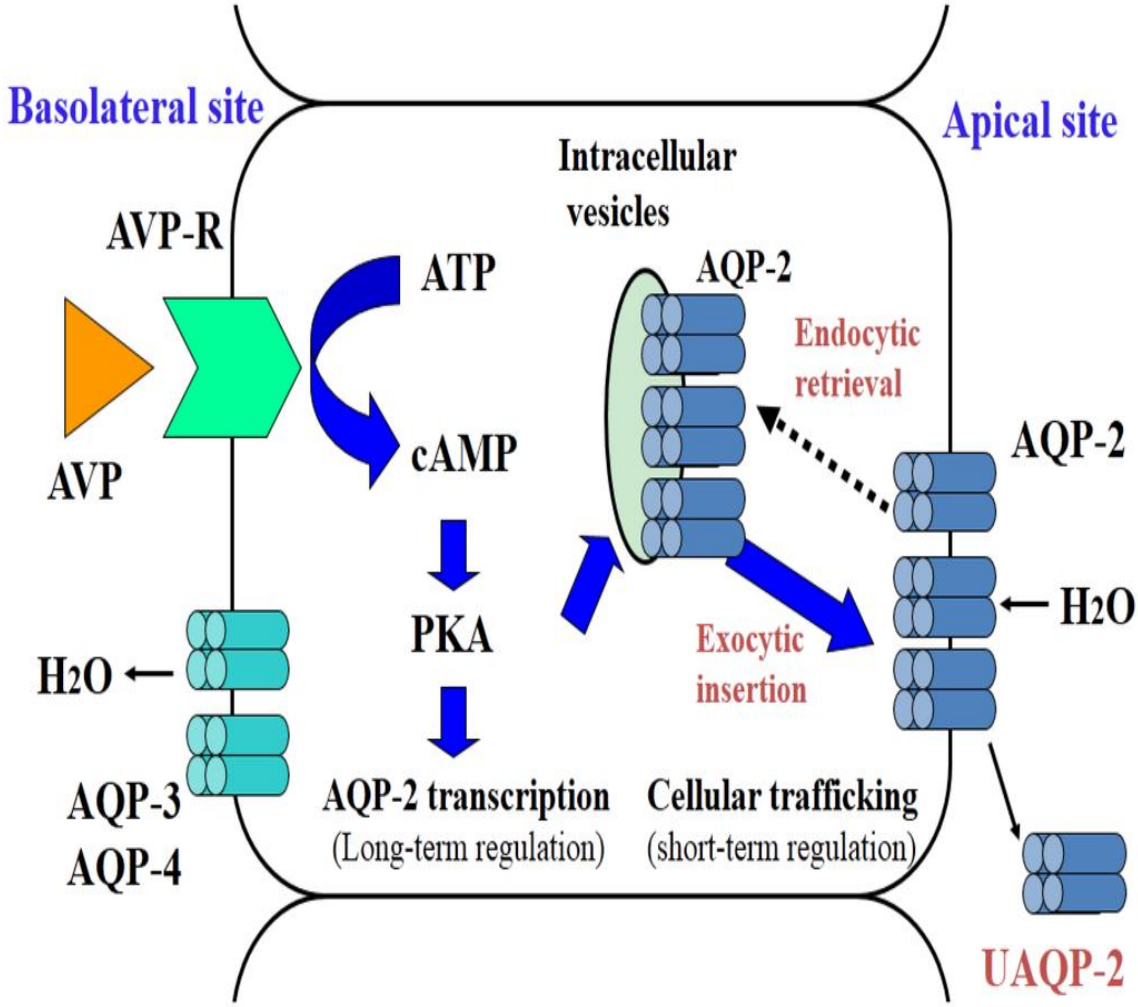


FIGURE 4: MECHANISM OF ACTION OF AVP

As AVP decreases urinary free water clearance, it causes dilution of high serum sodium concentration and returns osmolarity of serum to normal range. This causes feedback inhibition of AVP release from pituitary. The feedback inhibition also occurs via the improvement of any decreased intravascular volume or BP following water reabsorption, that might have contributed to the non-osmotic trigger for AVP release.(Figure 5)

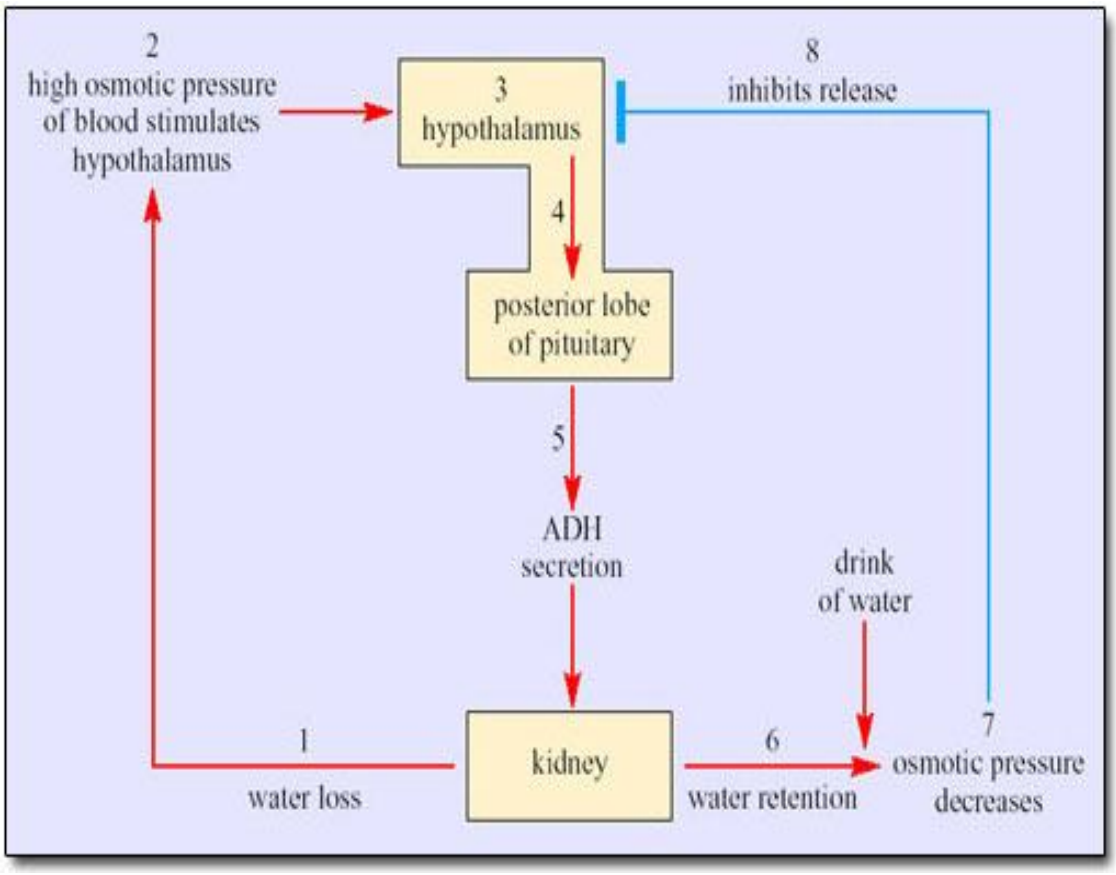


FIGURE 5: FEEDBACK INHIBITION OF VASOPRESSIN SECRETION

THIRST CONTROL:

To understand water balance physiology, both the water intake and output side of water balance must be appreciated. Therefore it is prudent to understand thirst regulation that controls water intake.

To begin with, hypertonicity not only stimulates AVP release but also the thirst as well. The consequent water intake together with AVP release restores normal tonicity. However thirst control is less sensitive than AVP in

regulating plasma osmolarity. Also, thirst regulation is complicated by other factors.

The plasma osmolarity required for thirst stimulation is approximately 10 mOsm higher than that required for AVP release[4].(Figure 6) Therefore, to stimulate thirst 2-3% increase in osmolarity is required compared with 1% increase for AVP release.

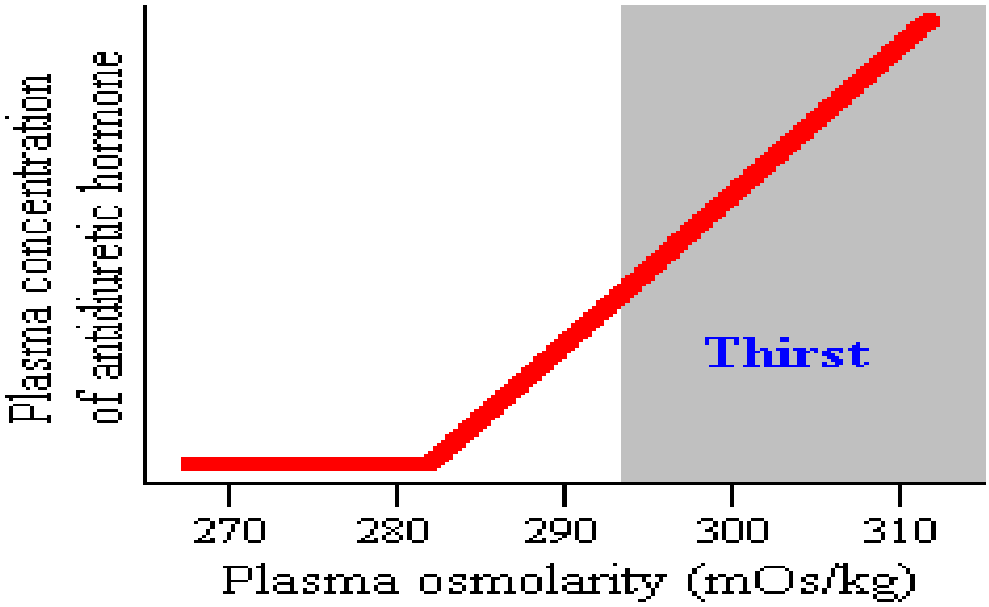


FIGURE 6: THIRST STIMULATION

The osmotic set point for stimulation of thirst occurs at the point when the urine is maximally concentrated by the action of AVP. In other words, water intake is increased only when the kidneys ability to retain water is at its maximum. Also thirst is influenced by other factors such as mouth dryness, hypovolemia, hypotension etc.,[18,19]. It can be suppressed by mechanoreceptors in oropharyngeal area when they sense fluid intake[20].

In contrast to AVP's minute to minute water regulation, thirst regulation that acts via gastrointestinal absorption of water, takes upto one hour for the correction of osmolarity. Thus thirst regulation acts like a second line of defense in water balance. Transient suppression of AVP and thirst occurs when there is overcorrection with rapid fluid intake, which prevents drop in serum osmolarity.

Thirst control and regulation of concentration of urine helps in the maintenance of water balance despite wide variations in water intake and output. When this balance is disrupted, dysnatremias occur.

HYPONATREMIA

Hyponatremia is defined as plasma concentration of sodium less than 135mEq/L[21]. Hyponatremia is a common occurrence in patients getting admitted to hospitals especially in Intensive Care Unit. It has been found that 15-30% of patients have low serum sodium concentration at some point during admission[22]. It usually results when kidney is unable to excrete a water load or excess intake of water.

Hyponatremia usually occurs when there is an increase in AVP or increase in renal sensitivity to AVP, in addition to excess free water intake[7]. Hence, this disorder can occur when there is increase in TBW, or decrease in solutes or combination of both. In most cases multiple mechanisms are operant. In assessing a patient with hyponatremia, the first step is to ensure that the decrease in serum sodium is due to a hypoosmotic state and not due to pseudohyponatremia or translocational hyponatremia.

Pseudo-hyponatremia:

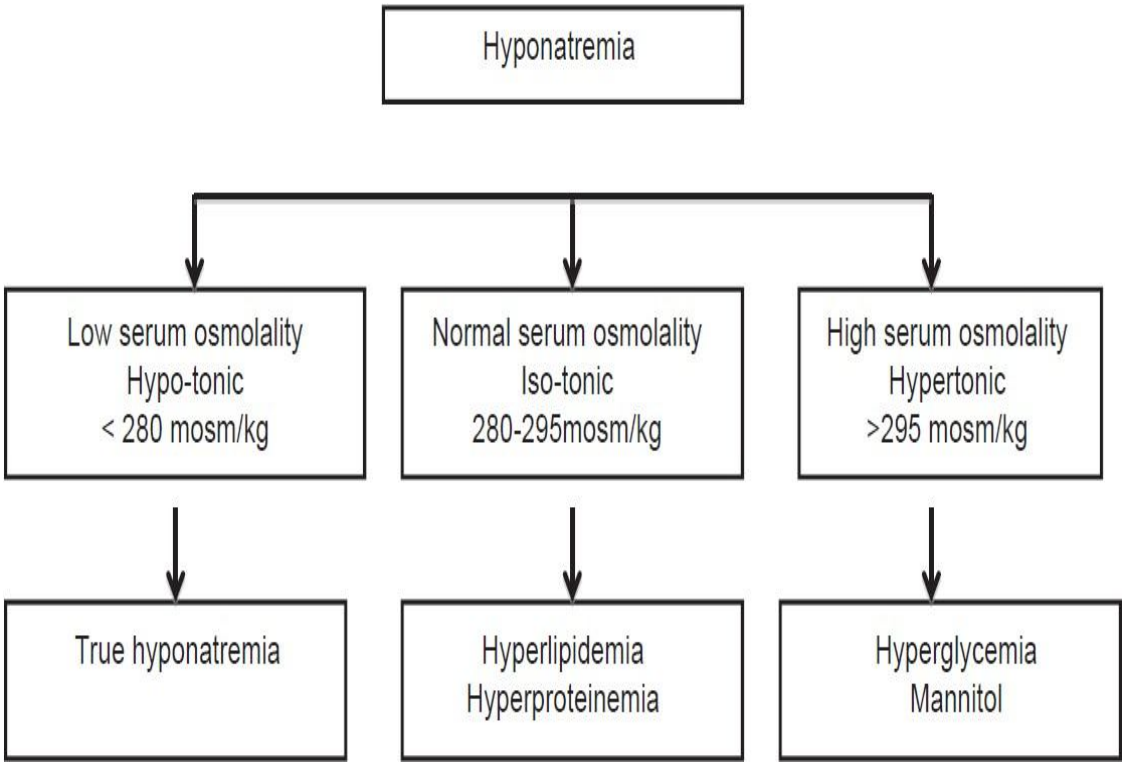
It is also called normo-osmolal or isotonic hyponatremia. It is due to increase in triglycerides or increase in plasma proteins in conditions like Multiple Myeloma. In normal individuals, plasma water accounts for 93% of plasma volume and proteins, fats contribute to the remaining 7%. In hypertriglyceridemia or hyperproteinemia, the contribution of plasma water to plasma volume is reduced to 80%[23,24]. Plasma osmolality and plasma water sodium concentration remain unchanged. However, the measured sodium

concentration is reduced because of the lowered plasma water concentration in the sample.

Translocational Hyponatremia:

It is also called hypertonic or redistributive hyponatremia. It is due to the presence of glucose or mannitol, that are osmotically active solutes[25]. The presence of significant amounts of these unmeasured solutes in plasma hinders the calculation of accurate plasma osmolality warranting direct measurement.

FIGURE 7: TYPES OF HYPONATREMIA

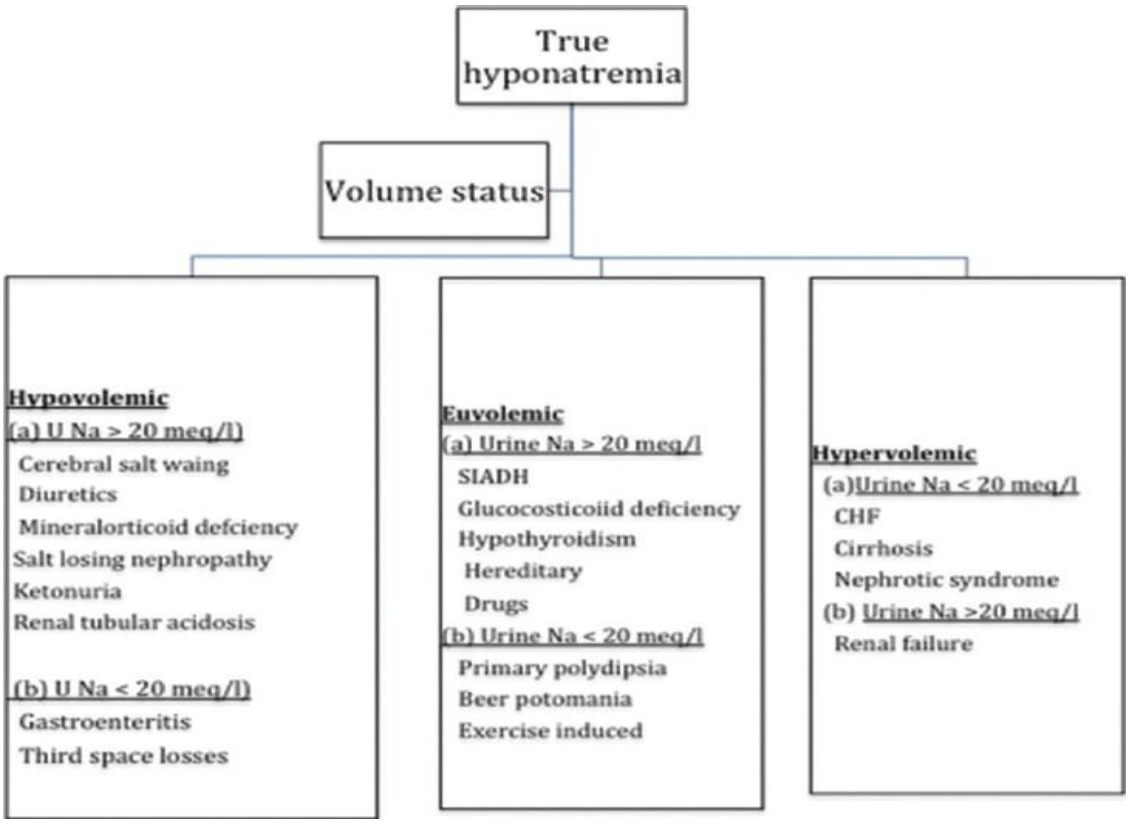


After excluding pseudohyponatremia and the presence of osmotically active solutes in ECF, assessment of ECF volume provides a useful way of

classifying true hyponatremia(hypoosmolal hyponatremia) as it can be associated with low, normal or increased total body sodium.

1. Hyponatremia with depletion of ECF volume – Hypovolemic Hyponatremia
2. Hyponatremia with excess ECF volume – Hypervolemic Hyponatremia
3. Hyponatremia with normal ECF volume – Euvolemic Hyponatremia

FIGURE 8: CLASSIFICATION OF HYPONATREMIA BASED ON ECF VOLUME STATUS



HYPOVOLEMIC HYPONATREMIA:

It arises when the decrease in total body sodium is out of proportion to decrease in total body water. AVP release is triggered by the decrease in intravascular volume and fall in blood pressure. This non osmotic stimuli overrides the suppression of AVP release by osmoreceptors that detect hypoosmolality, as described in the “Law of the Circulating Volume”. It states that the preservation of blood volume and maintenance of blood pressure takes precedence over maintenance of tonicity.

AVP acts on the V_{1A} receptors in blood vessels and V_2 receptors in kidney to maintain blood pressure and increase water absorption respectively. V_2 receptor activation can lead to hyponatremia if there is increased free water intake.

Table 4 shows the causes of Hypovolemic hyponatremia classified on the basis of $U_{[Na]}$.

$U_{[Na]}$ <10	$U_{[Na]}$ >20
Extra Renal Causes • Diarrhea • Vomiting • Third Space - Burns - Pancreatitis - Trauma - Muscle	Renal Causes • Diuretic Excess • Mineralocoticoid Excess • Salt Losing Nephritis • Bicarbonaturia(Renal Tubular Acidosis, Metabolic Alkalosis) • Ketonuria • Osmotic Diuresis

TABLE 4: CAUSES OF HYPONATREMIA BASED ON U_{Na}

HYPERVOLEMIC HYPONATREMIA:

It is a condition in which both total body sodium and water are increased, but the retention of water is out of proportion to the retention of sodium. This is mostly seen with disorders with edematous states such as cirrhosis, heart failure and the severity of hyponatremia is thought to serve as a marker of severity as well as prognostic indicator of the underlying disease. The mechanism by which hyponatremia occurs in these disorders can be attributed to the hormonal and intra-renal changes related to low Effective Arterial Blood Volume(EABV)[26].

Hyponatremia is seen in patients with advanced Congestive Heart Failure(CHF)[27,28]. It is an indicator of poor prognosis[29]. Cardiopulmonary

congestion and decreased left sided output results in underfilling of arteries. This is sensed by the mechanoreceptors present in left ventricle, aortic arch, carotid sinus and afferent arterioles in kidney[30]. Activation of these receptors leads to increased sympathetic outflow, activation of renin-angiotensin-aldosterone system which causes a decrease in GFR and increase in proximal tubular reabsorption. This leads to decreased delivery of water to distal nephron and inability to achieve adequate medullary interstitial tonicity gradient, thus causing an impairment of free water clearance. Activation of mechanoreceptors also causes non osmotic release of AVP and thirst stimulation. AVP release and increased free water intake due to thirst combine to produce hyponatremia. Also, expression of AQP2 has been shown to be increased causing greater absorption of water in the presence of AVP in animal studies with advanced CHF[31].

Cirrhosis is another condition in which hypervolemic hyponatremia can be seen. Vasodilation in splanchnic and peripheral circulation leads to low EABV. This low EABV, like in CHF leads to hyponatremia.

Hypervolemic hyponatremia has been reported in Nephrotic syndrome also, but their presence is inconsistent and unrelated to the severity of disease. Hypervolemic hyponatremia has also been reported in patients with renal failure(either acute or chronic)[32,33]. Recent studies have showed a 15% prevalence of hyponatremia in chronic kidney disease(CKD) patients.

EUVOLEMIC HYPONATREMIA:

This results when there is an increase in total body water without change in the level of total body sodium. This type of hyponatremia is encountered mostly in hospitalized patients[32] and attributed to various causes that has a common mechanism- the release of AVP is unregulated and unprovoked by either osmotic or non-osmotic factors. Syndrome of Inappropriate Anti-Diuretic Hormone(SIADH) is the most well recognized cause of euvolemic hyponatremia. It is the most common etiology of hyponatremia[34]. Table 5 shows other causes of euvolemic hyponatremia.

TABLE 5: CAUSES OF EUVOLEMIC HYPONATREMIA

URINE Na >20 mEq/L	URINE Na < 20 mEq/L
• SIADH • Glucocorticoid deficiency • Hypothyroidism • Drugs	• Primary polydipsia • Beer potomania • Exercise induced

SYMPTOMS:

Signs and symptoms of hyponatremia varies with the rate at which the serum sodium concentration declines and the age of the patient. Usually, young patients tolerate a specific level of hyponatremia better than elder patients. However, sudden onset of hyponatremia in a previously healthy adult may

cause severe neurologic signs and symptoms such as altered sensorium, convulsions and even death, though the serum sodium level is only between 125-130 mEq/L.

The severe clinical manifestations to sudden decline in serum sodium can be attributed to the inability of the brain cells to extrude osmotically active particles in a short time which can lead to brain swelling. However this protective mechanism becomes operant in chronic hyponatremia that an elderly person can present with minimal signs or symptoms even when the serum sodium level is around 110 mEq/L. Patients with chronic hyponatremia may be asymptomatic or present with lethargy, anorexia, nausea, muscle cramps, frequent falls or gait disturbances.

DIAGNOSIS:

History and Examination:

History and physical examination should be done in a way to identify findings that are typical for a specific cause of hyponatremia[35,36].

- History of volume loss such as diarrhea, vomiting with signs such as orthostatic hypotension, loss of skin turgor, dry mucous membrane
- Signs of volume overload in the form of peripheral edema, ascites due to cirrhosis, cardiac failure and renal failure

- To look for any one of the causes of SIADH such as CNS disease or small cell carcinoma of lung
- Prolonged intake of drugs that are known to cause hyponatremia
- Symptoms and signs indicative of hypothyroidism or adrenal insufficiency

Although history and examination can give a clue to the diagnosis it is prudent to establish the diagnosis with laboratory investigations.

LABORATORY INVESTIGATIONS:

1. **Measurement of Serum Sodium:**

   Ideally done by ion specific electrode(ISE) using direct potentiometry to prevent Pseudohyponatremia. However most laboratories use ISE with indirect potentiometry in which plasma sample is diluted before measurement.

2. **Serum Osmolality:**

   Most patients have a serum osmolality less than 275mOsm/L. It helps in ruling out Pseudohyponatremia and hyperosmolar hyponatremia.

3. Urine Osmolality:

It is used to distinguish between hyponatremia with normal water excretion and impaired water excretion.

TABLE 6: CAUSES OF HYPONATREMIA BASED ON URINE OSMOLALITY

URINE OSMOLALITY >150 mOsm/Kg	URINE OSMOLALITY <150 mOsm/Kg
• Hypovolemic hyponatremia • Cerebral salt wasting • Salt depletion • Euvolemic hyponatremia with high urine Na • Adrenal insufficiency • SIADH	• Euvolemic hyponatremia • Hypovolemic hyponatremia • Acute diuretic use • Primary polydipsia • Beer potomania • Exercise induced hyponatremia • SIADH (reset osmostat variety)

4. Urine Sodium Concentration:

It is used to differentiate between renal and extrarenal loss of sodium in hypovolemic hyponatremia. In patients with normal handling of electrolytes by the kidney, the appropriate response to hypovolemia is to increase tubular reabsorption of sodium such that Urine Na^+ is less than 10 mEq/L. If urine Na^+ is more than 20 mEq/L, it implies either euvolemia as in SIADH or hypovolemic hyponatremia with renal salt

wasting. The latter condition may arise from dysfunctional tubular transport due to diuretics, hypoaldosteronism or intrinsic renal disease.

5. Urine to Serum electrolyte ratio:

It is calculated by dividing the sum of urine sodium and potassium concentrations by the serum sodium concentration.

- If it is <0.5, it implies more of electrolyte free water in urine and fluid correction alone is enough in treatment
- If it is >1, it implies urine is hypertonic than serum and in addition to fluid restriction, other pharmacologic measures are needed in treatment[37].

6. Fraction excretion of Sodium: [FENa]

It is better than urine sodium in providing an accurate assessment of volume status because it corrects the effect of variations of urine volume that can have an impact on urine sodium. The cut-off for patients with hyponatremia and normal renal function is 0.1%.

- If FENa < 0.1%, it indicates hypovolemic hyponatremia
- If FENa > 0.1%, it indicates hypervolemic or euvolemic hyponatremia

7. Serum Uric Acid and Urea:

Low serum uric acid and urea:

i. SIADH

ii. Hypopituitarism

iii. Hypervolemia

iv. Thiazide diuretic induced hyponatremia

Normal serum uric acid and urea

i. In hypovolemia, the serum uric acid and urea levels may be normal or high.

8. Acid Base and Potassium Balance:

It may be helpful in some patients[38].

TABLE 7: CAUSE OF HYPONATREMIA BASED ON ACID BASE STATUS AND POTASSIUM IMBALANCE

ACID BASE IMBALANCE	POTASSIUM IMBALANCE	CAUSES
Metabolic alkalosis	Hypokalemia	Diuretic use or vomiting
Metabolic acidosis	Hypokalemia	Diarrhea or laxative abuse
Metabolic acidosis	Hyperkalemia	Primary adrenal insufficiency in patients without renal failure
Normal	Normal	SIADH
Mild metabolic alkalosis	Normal	Hypopituitarism

9. Saline Infusion:

If diagnosis is doubtful, one can administer 0.9% NaCl with serum sodium monitoring and follow up at 6 hours. Patients with hypovolemic hyponatremia usually improve with 0.9% NaCl administration while hyponatremia due to SIADH does not improve or may get worsened.

OTHER INVESTIGATIONS:

Thyroid Profile, CT/MRI Brain/Chest, ACTH and ACTH stimulation tests can be done depending on individual patients' presentation.

TREATMENT:

Treatment depends on

1. Volume status
2. Duration of hyponatremia (Acute- Less than 48 hours; Chronic- More than 48 hours)
3. Presence or absence of symptoms
4. Cause of hyponatremia[35,39,40,41]

EUVOLEMIC HYPONATREMIA:

- **Acute Hyponatremia:**

Rapid correction is necessary as there is increased risk of brain herniation. It is common in patients with primary polydipsia, marathon runners and ecstasy users. Recent recommendations suggest that a bolus of 100ml 3%NaCl be given over 10 mins. It can be repeated upto 3 times till acute symptoms subside. A total of 4-6 mmol/L correction is needed to prevent herniation of brain. For patients with mild to moderate symptoms and low risk of brain herniation, 3% NaCl infusion can be given at the rate of 0.5-2ml/kg/hour[21].

- **Chronic Hyponatremia:**

Chronic hyponatremia that presents with seizures or confusion and severe(serum concentration less than 125 mEq/L) must be treated

with 3% NaCl as in acute hyponatremia with a goal of 4-6 mmol/L rise above baseline.

Patients with mild symptoms such as dizziness, gait disturbances can be treated less aggressively.

- Fluid restriction when the urine to serum electrolytes is <0.5
- When the urine to serum electrolytes ratio is >1, in addition to fluid restriction, pharmacotherapy with salt tablets and loop diuretic can be used.
- An alternative approach is to start with vasopressin antagonist without fluid restriction.

Rate of Correction:

In chronic hyponatremia, the brain undergoes adaptation and hence the risk of herniation of brain is low. Hence, gradual correction is suffice to correct hyponatremia. Rapid correction may lead to Osmotic Demyelination Syndrome(ODS). Patients with serum sodium <120mEq/l, liver diseases, hypokalemia, alcoholism, malnutrition etc are at risk for ODS.

In patients with low risk of ODS, 4-8 mmol/day rise is suffice to correct symptoms of hyponatremia with a maximum of 10-12

mmol/day. In patients with high risk of ODS, 4-6 mmol/day rise is considered enough with a maximum of 8 mmol/day.

OSMOTIC DEMYELINATION SYNDROME:

It is a rare and severe disorder that can be irreversible at times. It presents with locked in state quadriparesis with preserved vertical eye movements. It was previously called Central Pontine Myelinolysis, but the name was changed as the demyelination involves other areas also. Though adaptations in chronic hyponatremia prevents brain swelling, it also increases risk of ODS from rapid correction. Recent studies have revealed that ODS can be reversed by lowering sodium and treatment with Desmopressin.

ASSESSMENT OF EFFICACY OF INITIAL THERAPY:

Increase in serum sodium following administration of one litre of a solution to a patient with hyponatremia can be calculated by Adrogue Madias formula.

Increase in Serum Na = (Infusate Na- Serum Na) / TBW + 1,

where, TBW – Total Body Water is calculated from lean body weight. Potassium, when added to the solution should also be included(“Infusate Na + K”)as treatment of concurrent hypokalemia can increase the serum sodium concentration. Infusate Na for various solutions is given in table 8.

SOLUTION	INFUSATE Na mEq/L
5% NaCl	855
3% NaCl	513
0.9% NaCl	154
Ringer Lactate	130

TABLE 8: SODIUM CONTAINING SOLUTIONS AND THEIR CONCENTRATION

This formula has limitations and cannot predict the magnitude of change in serum sodium accurately. Present guidelines do not recommend the use of formula. Rather, it is predicted that 1ml/kg of 3% NaCl raises the serum Na by 1 mEq/L.

HYPOVOLEMIC HYPONATREMIA:

Sodium Chloride as 0.9% NaCl is usually administered as it can correct the volume deficit. 3% NaCl is not indicated. 0.9% NaCl acts by two mechanisms. It improves the serum sodium by 1 mEq/L for every 1 litre of fluid administered and by correcting hypovolemia, decreases the stimulus for release of AVP. Potassium should also be monitored and corrected. Hyponatremia caused by thiazide diuretics is usually chronic and hence rapid correction should be avoided in view of ODS. These patients are more prone

for recurrence and should not be restarted on Thiazides. Vaptans are not indicated for hypovolemic hyponatremia.

HYPERVOLEMIC HYPONATREMIA:

Hypervolemic hyponatremia is seen in CHF and Cirrhosis. 3% NaCl is usually contraindicated for chronic treatment in edematous patients. It can be given in patients with acute hyponatremia as discussed above.

Water restriction remains the mainstay of treatment. Fluid restriction less than 750 ml to be followed by cirrhotic patients which is difficult. The cornerstone for therapy in hypervolemic hyponatremia is Loop Diuretics. Terlipressin, V_{1a} receptor agonist is used in patients with hepatorenal syndrome.

VASOPRESSIN RECEPTOR ANTAGONISTS: (VAPTANS)

They are antagonists of vasopressin receptors. There are multiple receptors for vasopressin: V_{1A}, V_{1B}, V_2. V_{1A} causes vasoconstriction; , V_{1B} causes ACTH release and V_2 receptors cause antidiuresis. Vaptans cause water loss without alterations in sodium and potassium excretion. They do not cause renal impairment and do not stimulate neurohormonal system. Thus they act as the appropriate physiological approach to hyponatremia and fluid restriction is not required. They are marketed as oral or iv formulations. Non Selective vaptans act on all the three receptors, while selective vaptans act on specific receptors.

NON SELECTIVE(V1 & V2)	CONIVAPTAN(I.V.)
SELECTIVE V_{1A} RECPTOR ANTAGONIST	RELCOVAPTAN
SELECTIVE V_{1B} RECPTOR ANTAGONIST	NELIVAPTAN
SELECTIVE V_2 RECPTOR ANTAGONIST	LIXIVAPTAN, MOXAVAPTAN, SATAVAPTAN, TOLVAPTAN

TABLE 9: CLASSIFICATION OF VAPTANS

Tolvaptan and Conivaptan are available in India.

Vaptans in Euvolemic Hyponatremia:

Vaptans are usually not used as a single agent in hyponatremic emergencies. Sometimes it can be used as an adjunctive therapy to 3% NaCl. Vaptans are used in chronic hyponatremia in addition to fluid restriction and sodium chloride administration[42,43].

Vaptans in Hypervolemic Hyponatremia:

Vaptans can be used in patients with CHF for correction of fluid overload and/or hyponatremia after initial trials with water restriction and fluid overload. Various studies have demonstrated hyponatemia in CHF is associated with increased mortality and re-admission rates. CHF is associated with chronic hyponatremia and thus should be corrected till serum Na levels become normal so that dosage of diuretics can be optimized.

Vaptans can be used in patients with decompensated liver disease for management of hyponatremia after initial treatment with fluid restriction and diuretics. Tolvaptan was found to be hepatotoxic and hence USFDA limited their use to end stage liver disease patients where liver transplantation is imminent and correction of hyponatremia before surgery will decrease the risk of ODS postoperatively. Although studies have shown that vaptans help in improving serum sodium levels, there was no difference between vaptans and control groups with regard to mortality and complications of decompensated liver disease.

Contraindications to Vaptans:

Vaptans are contraindicated in hypovolemic hyponatremia. They should not be used in euvolemic hyponatremia patients caused by emetic stimuli and secondary adrenal insufficiency. They are found to be ineffective in SIADH caused due to activating mutation of V_2 receptor. In cerebral salt wasting and psychogenic polydipsia, where AVP levels are inappropriate, Vaptans are found to be ineffective.

Adverse Effects:

Thirst, Orthostatic Hypotension, Dryness of mouth and Encephalopathy.

HYPERNATREMIA

Hypernatremia defined as a serum concentration of sodium more than 145 mEq/L, occurs in about 1% of hospitalized patients[44] and 7% of patients who are admitted in intensive care unit[45]. Though it is uncommon to be a primary cause for death, as much as 40% mortality has been reported in patients with hypernatremia.

PATHOPHYSIOLOGY:

Hypernatremia results from disequilibrium of water balance in which there is excess of Na in relation to water in ECF. Mostly it results from water deficit and at times due to sodium overload. Water deficit results from inadequate intake or excessive water loss. Patients with appropriate thirst response and access to fluid intake compensate to these changes.

As a result of increased sodium in the ECF, the osmotic load increases and this is compensated by loss of water from inside the cells. This causes shrinkage of the cells due to dehydration. The cells respond to this shrinkage by transporting solutes across the cell membrane, thus altering the resting potentials of electrically active cell membrane. To avoid structural damage and restore the cell volume, organic solutes are generated intracellularly.

The effects of cellular dehydration and shrinkage with altered membrane potentials are primarily manifested in the CNS leading to ineffective

functioning. When shrinkage of neuron is severe, it leads to stretching and may cause rupture of bridging veins.

Infants, elderly and debilitated patients are dependent on the caregiver for providing water. They are more prone for hypernatremia. Essential or adipsic hypernatremia occurs as a result of congenital or acquired defect of osmoreceptors present in hypothalamus. This leads to dysregulation of vasopressin release and thirst response leading to hypernatremia with hypovolemia.

Renal water loss occurs as a result of inability of the distal tubule to concentrate urine. This may result from failure of vasopressin action which leads to defective reabsorption of water. It can be due to,

1. Inadequate Pituitary Secretion - Central Diabetes Insipidus

2. Resistance at the level of receptors – Nephrogenic Diabetes Insipidus

These patients excrete excess amount of dilute urine and do not develop hypernatremia as long as they can maintain increased water intake to compensate their losses. Another common cause for excess loss of water through renal system is osmotic diuresis. This can be secondary to hyperglycemia, mannitol, excess urea and post-obstructive diuresis.

Extra renal fluid loss can occur in the setting of fever, severe burns, exposure to heat, vigorous exercise and mechanical ventilation. Diarrhea is the leading cause of hypernatremia due to gastrointestinal pathology. Osmotic

diarrhea is more likely to cause hypernatremia than secretory diarrhea. Osmotic diarrhea and viral gastroenteritis produce stools with Na^+ and K^+ < 100 mM thus causing hypovolemia and hypernatremia. Secretory diarrhea produces isotonic stools and cause hypovolemic hyponatremia.

Sodium excess due to use of intravenous fluids(0.9% NaCl) to correct insensible water loss can lead to hypernatremia. It can also be seen after sodium bicarbonate administration in metabolic acidosis, use of high sodium dialysate and intrauterine instillation of hypertonic saline for pregnancy termination.

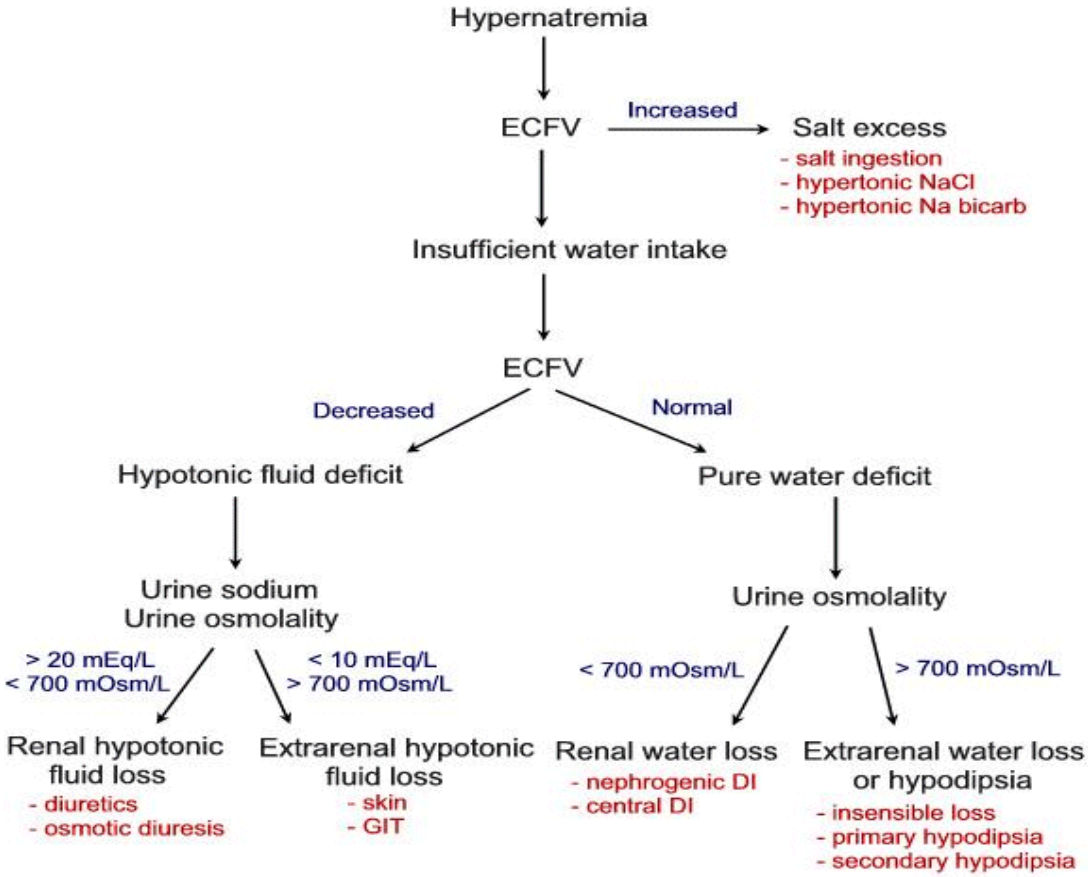


FIGURE 9: APPROACH TO HYPERNATREMIA

CLINICAL FEATURES:

Patients present with non specific symptoms that are predominantly neurological. They include lethargy, coma and seizures. Hypernatremic hypovolemia can precipitate venous sinus thrombosis. Shrinkage of brain due to hypernatremia can lead on to tearing of blood vessels to cause hemorrhage.

While examining the patient it is prudent to assess fluid volume status to categorize the etiology of hyponatremia. Signs of hypovolemia such as orthostatic hypotension, tachycardia should be looked for. Since these patients usually present with neurologic manifestation, it is important that complete neurologic examination be done.

LABORATORY INVESTIGATIONS:

When serum sodium is found to be high, one should obtain urine osmolality and sodium levels. Serum glucose levels should be checked to rule out osmotic diuresis.

- If urine osmolality is high, the concentrating ability of the kidney is normal and extrarenal loss of fluid should be suspected. Normal urine osmolality is associated with osmotic diuresis.

- In case of hypotonic urine with polyuria, DI should be suspected.

CT or MRI of the Brain should be done to rule out hemorrhage or venous thrombosis. Water deprivation test and ADH stimulation test should be done to evaluate for Diabetes Insipidus.

TREATMENT:

The treatment of hypernatremia patients involve two steps.

1. Correction of plasma tonicity

2. Diagnosis and treatment of underlying disorder

It should be remembered that hypernatremia should not be corrected at a rate more than 1mEq/L per hour. Fluid deficit should be calculated by,

Water Deficit = Total Body Water*([Serum Na/140]-1)

The change in serum sodium can be estimated by Adrogue-Madias formula.

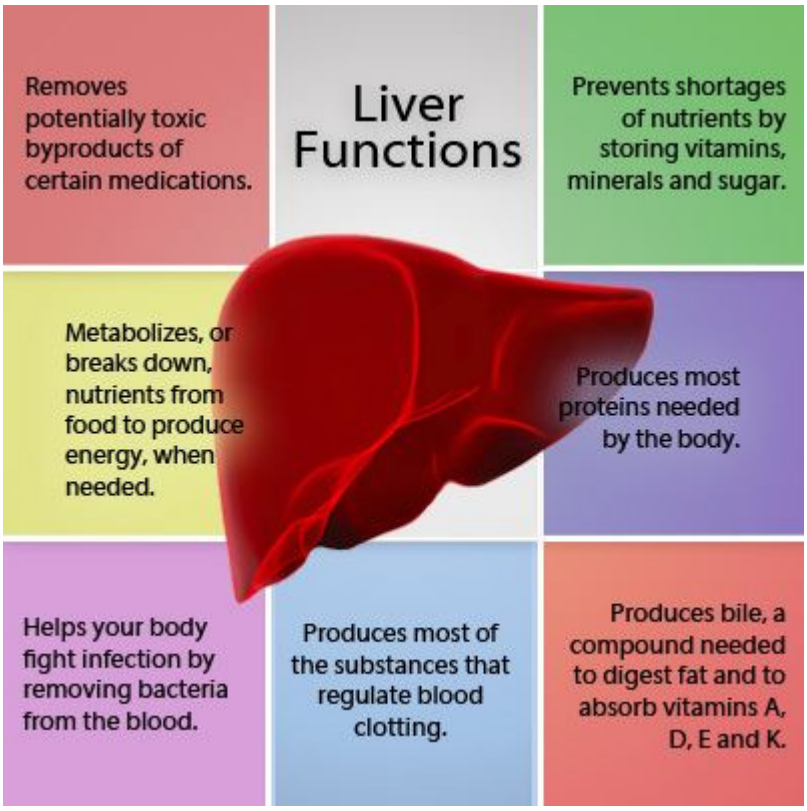
Change in Serum Na = (Infusate Na- Serum Na) / TBW + 1

In hemodynamically unstable patients with hypovolemic hypernatremia, correction of vital signs with isotonic saline should be done before correcting free water deficits with hypotonic fluids. Euvolemic hypernatremia should be corrected with hypotonic fluids, either intravenously(dextrose 5% in water[D5W] or half isotonic sodium chloride) or orally. Hypervolemic hypernatremia should be treated with D5W to remove excess sodium. In central DI, desmopressin increases cellular permeability of collecting tubules and promotes reabsorption of water. It has been advocated for long term therapy in central DI. Patients with Nephrogenic DI must be taught to avoid salt and take large amounts of water. The underlying cause of hypernatremia should be found and treated.

LIVER

Adult liver, weighing about 1.4-1.6 kg and contributing to 1.5-2.5% of lean body mass, is the largest internal organ in the human body. It performs various essential functions such as synthesis of plasma proteins; detoxification of endogenous and exogenous toxic metabolites; balancing the metabolism of carbohydrates, proteins and fats; secretion of bile etc., as shown in figure.

FIGURE 10: FUNCTIONS OF LIVER



DECOMPENSATED CHRONIC LIVER DISEASE:

Chronic liver disease indicates a disease of the liver that causes progressive destruction and regeneration of its parenchyma leading on to fibrosis and cirrhosis. Chronic liver disease is said to be present when the

disease process lasts for six months. It is important for the clinicians to differentiate patients of chronic liver disease into those who have compensated liver function and those who have decompensated liver function.

Patients with chronic liver disease can present with decompensation in any one of the following forms.

1. Ascites
2. Variceal Bleed
3. Hepatic Encephalopathy
4. Hepato Renal Syndrome
5. Coagulopathy
6. Hepatopulmonary Syndrome
7. Hepatocellular carcinoma

PATHOPHYSIOLOGY OF CHRONIC LIVER DISEASE:

Hepatocellular injury due to various etiologies is followed by degeneration or necrosis of the hepatocyte. Necrosis leads to kupffer cell activation and macrophage immigration. T lymphocytes are also attracted. They are stimulated by IL-1. Fibroblasts are also attracted and transformed into myofibroblasts, which are responsible for increased synthesis of collagen and extra cellular matrix.

Bridging fibrous septa are formed linking portal tracts with one another and also with terminal hepatic veins. Fibrosis is the prominent feature of progressive damage of the liver. Nodules are formed by cycles of hepatocyte scarring and regeneration. The consequent diffuse fibrosis causes disruption of the entire architecture of the liver. The histopathological consequence of chronic injury and inflammation with formation of fibrosis and nodularity surrounded by collagen bands is termed as cirrhosis.

This leads to reduced liver mass and impaired hepatocellular function. The distorted architecture provides mechanical resistance to normal blood flow through liver.

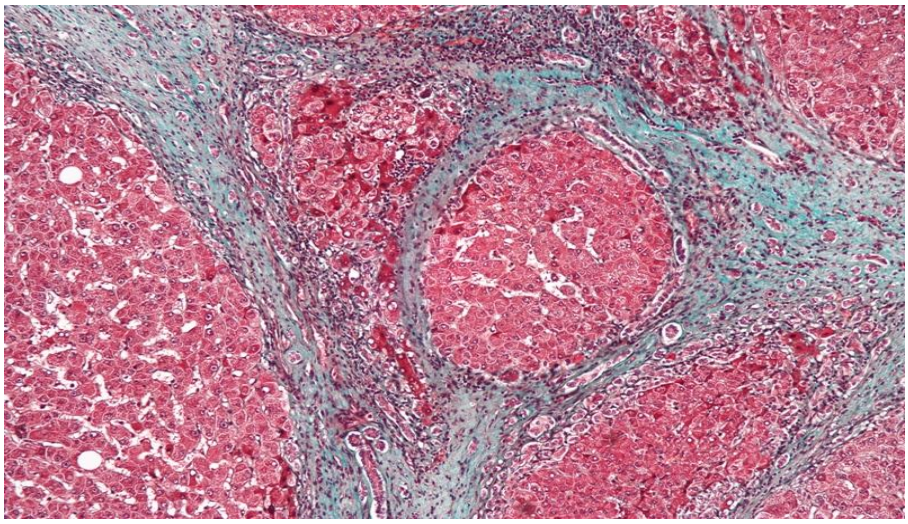


FIGURE 11: HISTOPATHOLOGY OF CIRRHOSIS showing architectural distortion and fibrosis with nodular regeneration

CLINICAL FEATURES:

Chronic liver disease has varied presentations as shown in Table 10. Any combination of the features listed may be present in an individual patient. Patient can present with weakness, fatigue, anorexia, nausea, vomiting, weight loss etc along with typical symptoms of hepatic insufficiency.

TABLE 10: CLINICAL FEATURES OF CHRONIC LIVER DISEASE

• Jaundice • Ascites • Spider telengiectasia, palmar erythema • Loss of libido, hair loss, testicular atrophy, impotence, gynaecomastia(male) breast atrophy, amennorhea(female)	• Bruises, purpura, epistaxis • Spleenomegaly, variceal bleeding • Pigmentation , digital clubbing.

CAUSES OF CHRONIC LIVER DISEASE:

Regardless of the etiology, the presentation and complications of cirrhosis are basically similar. Still, it is prudent to classify the patients on the basis of their etiology. Table 11 lists the various causes of chronic liver disease.

• Alcoholism • Hepatitis B • Hepatitis C • Autoimmune Hepatitis • Nonalcoholic Steatohepatitis • Primary Biliary cirrhosis • Cardiac cirrhosis • Primary sclerosing cholangitis	• Wilson's Disease • Hemochromatosis • Cryptogenic Cirrhosis

TABLE 11: CAUSES OF DECOMPENSATED CHRONIC LIVER DISEASE

COMPLICATIONS:

The disease course of chronic liver disease is complicated when signs of decompensation develops. These complications occur in all cases regardless of the underlying etiology. Table 12 illustrates the various complications that occur following decompensation.

1. PORTAL HYPERTENSION • Gastroesophageal varices • Portal hypertensive gastropathy • Spleenomegaly • Ascites, Spontaneous Bacterial Peritonitis 2. HEPATIC ENCEPHALOPATHY 3. HEPATORENAL SYNDROME- TYPE I and II	4. HEPATOPULMONARY SYNDROME 5. PORTOPULMONARY HYPERTENSION 6. MALNUTRITION 7. COAGULOPATHY • FACTOR DEFICIENCY • THROMBOCYTOPENIA • FIBRINOLYSIS 8. HEMATOLOGIC ABNORMALITIES 9. BONE DISEASE

TABLE 12: COMPLICATIONS OF DCLD

PORTAL HYPERTENSION(PH)

Portal Hypertension is said to be present when the hepatic venous pressure gradient is more than 5 mmHg. It is caused due to the following mechanisms,

1. Resistance to passage of blood through liver due to cirrhotic changes
2. Dilatation of splanchnic vascular bed causing increased splanchnic blood flow

Portal hypertension account for two most common complications of chronic liver disease, Ascites and variceal hemorrhage. Endothelial dysfunction occurs in the hepatic circulation due to decreased Nitric Oxide(NO) production. Also, NO is consumed as a result of oxidative stress of cirrhosis. Increased splanchnic blood flow leads to relative hypovolemia which causes renal vasoconstriction and activates renin-angiotensin pathway. This leads to retention of sodium and water. Increased blood flow in portal system is diverted through portosystemic collaterals leading to development of intraabdominal varices.

Bleeding is the important complication of varices. Long term survival of patients with variceal bleeding is poor and it also depends on the severity of underlying hepatic pathology.

ASCITES:

It is a common presentation in patients with decompensation. The mechanism of development of ascites is attributed to increased splanchnic blood flow, reduced renal blood flow leading to activation of renin-angiotensin pathway and retention of sodium and water. Initially, as a result of decreased effective arterial blood volume, cardiac output is increased. As the disease progresses, systemic hypotension develops leading on to activation of multiple vasoconstrictor and anti natriuretic hormones in order to maintain homeostasis. As a result of hypoalbuminemia, oncotic pressure is decreased and fluid leakage occurs across the capillaries into peritoneal cavity. In the advanced

state, renal excretion of free water is decreased as a result of vasoconstriction and ADH activation as a result of perceived hypovolemia leading on to Dilutional Hyponatremia(DH).

SPONTANEOUS BACTERIAL PERITONITIS(SBP):

It is a common and severe complication of ascites. It is caused by spontaneous infection of the ascitic fluid. Bacterial translocation has been thought to be the reason for the development of SBP. Gut flora is assumed to traverse the intestine and reach mesenteric lymph nodes leading to bacteremia and seeding of ascitic fluid. It can occur in upto 30% of patients having ascites that is severe enough to require admission with a mortality rate of 25%. Diagnosis is made by an ascitic fluid neutrophil count of greater than 250. They present with fever, altered mental status, abdominal discomfort and elevated white blood cell count.

HEPATORENAL SYNDROME(HRS):

Functional renal failure without renal pathology occurring in patients with cirrhosis is termed Hepatorenal syndrome. Marked disturbances in renal circulation in the form of increased vascular resistance together with decreased systemic vascular resistance is thought to be the reason for development of HRS. The exact reason for renal vasoconstriction is thought to be multifactorial and poorly understood. Diagnosis of HRS is made in patients with large amount of ascites and a step-wise rise in serum creatinine. Two forms of HRS exist that affect 10% of patients with cirrhosis.

Type I HRS is associated with rapid deterioration of renal function with doubling of serum creatinine within a two week period. It is often precipitated by acute events such as SBP. The median time of survival without treatment in type I HRS is one month. Type II HRS is associated with slow decline in renal function that may lead on to refractory ascites.

HEPATIC ENCEPHALOPATHY:

Alteration in mental status and cognitive function in persons with hepatic failure is termed as hepatic encephalopathy. It is a serious complication of chronic liver disease. Neurotoxins derived from gut are not cleared by liver because of vascular shunting and decreased hepatic mass. They accumulate in brain to cause hepatic encephalopathy. Although ammonia levels are typically elevated in hepatic encephalopathy, correlation between ammonia levels and severity of liver disease is poor. Other substances implicated in hepatic encephalopathy are certain false neurotransmitters and mercaptans.

Encephalopathy in patients with liver disease is precipitated by factors such as infection, electrolyte disturbance, increased dietary protein load etc., clinical presentation may vary from inattention to coma. The pathology in brain may vary from edema to herniation. Hepatic Encephalopathy is graded by West Haven Criteria, shown in Table 13.

GRADE	CRITERIA
GRADE I	Trivial lack of awareness ; Shortened attention span; Euphoria or anxiety; Impaired performance of addition
GRADE II	Lethargy or apathy; Subtle personality change; Minimal disorientation for time or place; Inappropriate behaviour; Impaired performance of subtraction
GRADE III	Somnolence to semi-stupor, but responsive to verbal stimuli; Gross disorientation ;Confusion
GRADE IV	Coma (unresponsive to verbal or noxious stimuli)

TABLE 13: WEST HAVEN CRITERIA

DYSNATREMIAS IN DECOMPENSATED CHRONIC LIVER DISEASE

Hyponatremia is a frequent complication in patients with decompensated liver disease. It occurs due to the impaired free water clearance by renal tubules that leads to disproportionate retention of water when compared with sodium. This leads to reduction in serum sodium and hypoosmolality. Although hyponatremia in decompensated liver disease was described 50 years ago, interest in this area increased when studies done in 1980s indicated that hyponatremia is significant prognostic indicator.

Recent studies also showed that presence of hyponatremia is associated not only with poor outcome in patients who has not undergone transplants but also in post transplant patients.

HYPONATREMIA:

Although hyponatremia in general population is defined as the concentration of serum sodium less than 135 mEq/L, in patients with chronic liver disease and ascites, it is defined as serum sodium less than 130 mEq/L. Still, patients with serum sodium levels between 130 and 135 have pathogenic and clinical features almost similar to those with patients who have levels below 130 mEq/L. 21.6% of patients with DCLD have serum sodium less than 130 and 49.4% have levels less than 135 mEq/L.

TYPES OF HYPONATREMIA:

Patients with decompensated liver disease may develop either hypervolemic hyponatremia or hypovolemic hyponatremia.

Hypervolemic Or Dilutional Hyponatremia:

This is by far the most common type. It occurs in patients with increased extracellular fluid and edema. Hyponatremia here is due to impaired ability of kidney to excrete free water that results in disproportionate increase in water compared to sodium. Renal impairment is frequent but not always present with this type.

Hypovolemic Hyponatremia:

It is less common and occurs due to loss of fluid, mainly from kidney due to enhanced diuresis as a result of diuretic drugs or from gastrointestinal tract. It is associated with reduction in plasma volume, absence of ascites or edema, signs of dehydration and pre-renal renal failure. These patients show an improvement of sodium values after administration of normal saline or by increasing quantity of sodium in the diet.

Both types can be differentiated on the basis of volume status. In hypervolemic hyponatremia, the effective arterial blood volume is reduced in spite of the increase in absolute plasma volume owing to the marked dilatation of the arterial circulation.

PATHOGENESIS OF HYPONATREMIA IN DCLD:

Patients with decompensated liver disease and ascites have impairment in the ability of kidney to excrete solute free water[7,46]. In some patients, this impairment is only moderate and detected by measuring urine volume following a water load. These patients can eliminate water normally and maintain sodium concentration within normal limits as long as their intake of water is within normal range. When the intake of water is increased, these patients may develop hyponatremia and hypoosmolality. Figure 11 shows the mechanisms of renal water handling in these patients causing hyponatremia.

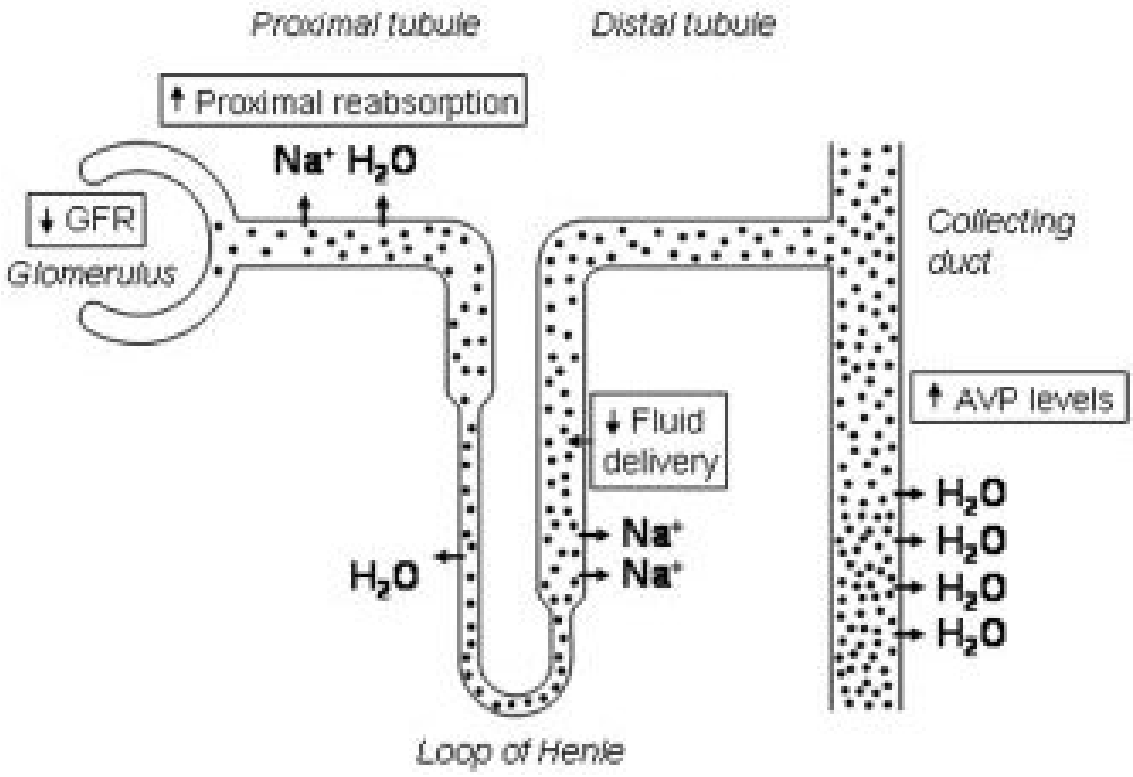


FIGURE 12: RENAL WATER HANDLING IN CIRRHOSIS

The important determinant of hyponatremia is increased secretion of AVP as a result of non-osmotic stimulation following circulatory changes in patients with decompensated liver disease.

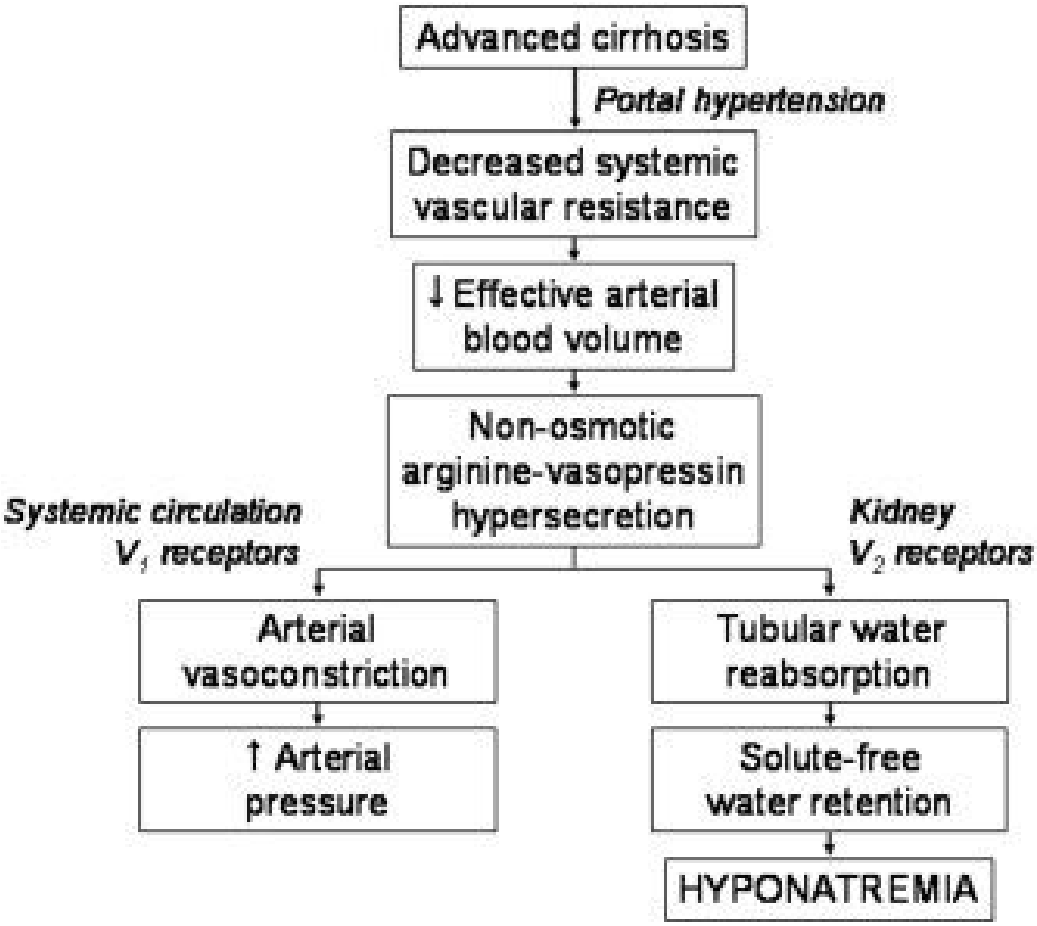


FIGURE 13: MECHANISM OF AVP SECRETION AND ITS EFFECTS

WATER RETENTION IN DECOMPENSATED LIVER DISEASE:

Water loading test is done by administration of 20 ml/kg body weight of water over 45 minutes. In normal individuals, water loading causes production of maximally dilute urine and increased urine output. In patients with compensated non-ascitic chronic liver disease, response to water load is

normal. However, in decompensated chronic liver disease patients, solute free water clearance is impaired after water load and the kidneys are unable to generate hypotonic urine.

Various studies have provided evidence that AVP is a major factor responsible for water retention in cirrhosis[47]. In a study of patients with cirrhosis and ascites, patients excreting more than 80% of water load over 5 hours were labelled excretors and those excreting less than 80% were labelled nonexcretors. Serum AVP concentrations were measured before and after water loading. It was found that although baseline AVP levels of nonexcretors were higher than that of excretors, the difference was not significant. However, the nonexcretors were unable to suppress the AVP levels as that of excretors after water loading and the difference was significant. The study also found a significant correlation between plasma AVP level and the percentage of water load excreted.

MECHANISM OF RETENTION OF WATER AND DILUTIONAL HYPONATREMIA:

Decreased Metabolism of AVP:

AVP is metabolized in liver and kidney. In patients with altered liver function due to chronic liver disease, metabolic clearance rate of AVP is decreased and its level increases. This alone does not explain the whole process of dilutional hyponatremia, as the increase in AVP levels should exert a negative feedback on its release if osmotic factor is alone responsible for the

regulation of AVP. The pathogenesis of dilutional hyponatremia is shown in figure 14.

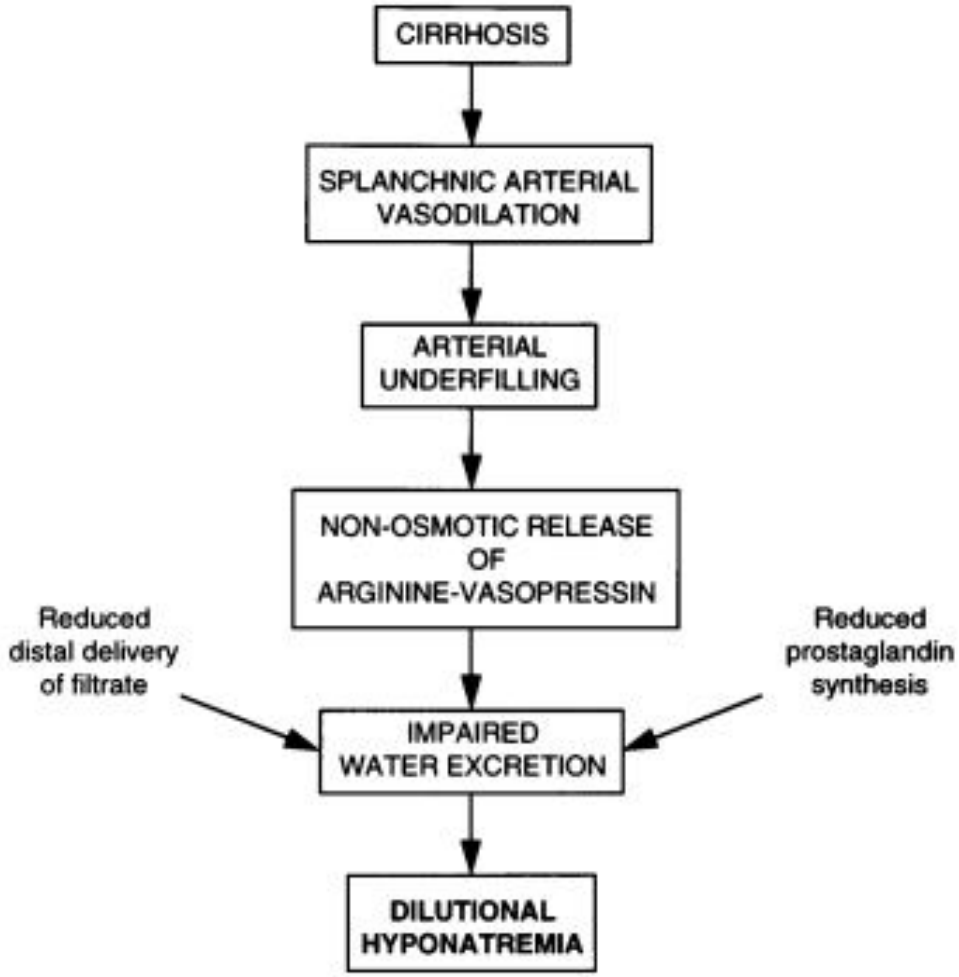


FIGURE 14: PATHOGENESIS OF DILUTIONAL HYPONATREMIA

Reduced Renal Prostaglandins:

Renal prostaglandins play a significant role in the balance between vasoconstrictor and vasodilator forces on the renal hemodynamics. This is particularly important in pathologic conditions such as decompensated liver

disease where vasoconstrictor forces predominate. Prostaglandins that cause vasodilatation such as PG I_2, PG E_2 are important to antagonize the effects of vasoconstrictors such as angiotensin, AVP, norepinephrine and increased sympathetic tone. In patients with decompensated liver disease, cyclooxygenase inhibition has been found to have a deleterious effect on renal hemodynamics with a decrease in renal blood flow and GFR. It has been found that prostaglandins inhibit AVP mediated water reabsorption[48]. These observations suggest that impairment of renal hemodynamics and reduced synthesis of prostaglandins such as PGE_2, PG I_2 together cause reduced free water excretion.

Decreased Distal Tubule Delivery:

Another mechanism proposed for impaired free water excretion is decreased delivery of the filtrate to the distal segment of the nephron. Lithium clearance, which is used to estimate delivery of filtrate to distal segment, is reduced in patients with decompensated liver disease with ascites[49]. It is also thought that this decreased delivery of sodium to distal tubules is responsible for impaired aldosterone escape and atrial natriuretic peptide resistance in decompensated liver disease and ascites[50].

Non Osmotic Release Of AVP:

In patients with hyponatremia and hypoosmolality, AVP release would be suppressed. The most reasonable explanation for raised AVP levels in decompensated patients would be non osmotic release of AVP. Anderson et

al[51] found that acute increase of portal vein pressure is associated with antidiuresis in dogs. Arterial vasodilatation which is characteristic of decompensated liver disease causes decreased EABV, which stimulates baroreceptors leading to non-osmotic secretion of AVP along with activation of antidiuretic and vasopressor systems[52]. This neurohormonal response is transient and occurs at the expense of increased plasma volume during the early stages of disease. As the disease progresses, the neurohormonal response cannot compensate for the arterial underfilling and leads to sodium and water retention, edema and ascites.

PROGNOSTIC SCORES:

The prognostic scores in decompensated liver disease are used for various reasons. They help in identifying patients at risk for developing complications, to predict the risks involved in various procedure such as porto-systemic shunts, to prioritize the patients waiting for Orthotopic Liver Transplantation(OLT).

CHILD- TURCOTTE PUGH SCORE: (CPS)

It was developed in 1964 by Child and Turcotte. It consisted of serum bilirubin, albumin, ascites, clinically apparent encephalopathy and malnutrition[53]. Each variable was given points according to the severity or cut-off ranges. The combined score is classified in to three groups of worsening severity(A,B,C). A modification of this score was put forward by Child-Pugh ten years later to predict outcome from surgical procedures used to reduce PH

and treat esophageal varices[54]. In the modified CPS, Prothrombin Time or International Normalized Ratio(INR) was included in the place of nutritional status and the lowest cut-off for albumin was reduced to 2.8mg/dl. Later, this score was used to predict the likelihood of survival in patients with cirrhosis. Table 14 shows the modified CPS.

TABLE 14: MODIFIED CPS

VARIABLE	**POINTS**		
	1	**2**	**3**
Serum Bilirubin(mg/dl)	<2	2-3	>3
Serum Albumin(mg/dl)	>3.5	2.8-3.5	<2.8
INR	<1.7	1.7-2.2	>2.2
Ascites	None	Mild	Moderate to Severe
Encephalopathy	None	Grade I-II	Grade III-IV
Class A- 5-6 points; Class B- 7-9 points; Class C- 10-15 points			

MELD SCORE: (The Model for End-stage Liver Disease)

It was initially developed to assess the likelihood of survival in patients with refractory ascites and undergoing Transjugular Intrahepatic Porto-

systemic shunt(TIPPS)[55]. Later, it was found to be helpful in ascertaining the prognosis and to prioritize patients for receipt of liver transplant.[56,57] United Network for Organ Sharing and Eurotransplant are using this score to prioritize patients for liver transplant.[57,58]

Initially MELD was calculated using the following variables: Bilirubin, Creatinine, INR and cause of cirrhosis. These four variables independently predicted survival in patients undergoing TIPPS in a multivariate Cox model.

MELD score = 9.6 loge (creatinine mg/dl) + 3.8 loge (bilirubin mg/dl) + 11.2 loge INR + 6.4 (cause of cirrhosis; 0 = cholestatic/alcohol, 1 = other)

Kamath et al found that the three month mortality rate predicted by MELD was similar across various cohorts of cirrhotic patients. Further, it was shown that eliminating the last variable did not alter the ability of score to predict prognosis. The present score is calculated by,

MELD = $3.78[\log_e$ serum bilirubin (mg/dl)] + $11.2[\log_e$ INR] + $9.57[\log_e$ serum creatinine (mg/dl)] + 6.43

POINTS TO BE REMEMBERED WHILE CALCULATING THE SCORE:

- The score ranges from 6-40 and any value more than 40 is taken as 40.
- It is used in patients 12 years and older.
- Maximum value for creatinine is 4. If patient is dialysed twice in the preceding week, creatinine value is taken as 4.

- If the value of a variable is less than one, it is taken as one.(Serum bilirubin value of 0.9 is taken as 1)

SERUM SODIUM AS A PROGNOSTIC MARKER:

The prognostic effect of serum sodium has been studied in patients with decompensated liver disease. A large study done on patients admitted for cirrhosis, has shown that the prevalence of hyponatremia to be 29.8%.[59] Low serum sodium levels were found to be an indicator of poor prognosis and short term in-hospital mortality. Low serum sodium levels were not found to be an independent predictor of mortality when compared with CPS.[60] Biggins et al showed that the ability of MELD score to predict three month waiting list mortality improved when serum sodium was added to it.[61] The mortality risk for patients with decompensated liver disease was found to be higher in patients with hyponatremia irrespective of the disease severity.[62]

HYPERNATREMIA IN DCLD:

Although hypernatremia is less common than hyponatremia in decompensated liver disease, Sanford E.Warren et al found that patients with hypernatremia and decompensated liver disease had a mortality of 87% and attributed the cause of hypernatremia to decreased water intake due to encephalopathy and osmotic cathartics usage.[16]

MATERIAL AND METHODS

SOURCE OF STUDY:

The study will be conducted on consecutive patients admitted with DCLD in Medical Wards (Male and Female) in Government Vellore Medical College and Hospital during the study period of one year from August 2014-July 2015.

METHOD OF COLLECTION OF DATA:

Ethical Committee clearance obtained from Institution. Informed consent was obtained from the patients enrolled in the study. The data of the patients were collected using a proforma. The first section of the proforma contains patient's demographic profile with detailed history. The second section contains detailed clinical examination that will be carried out at the time of admission. The third section contains investigations that were done to aid the diagnosis and the serum sodium level.

Patients were selected based on history, examination, laboratory investigations and imaging suggestive of the diagnosis of Decompensated Chronic Liver Disease. The presence of various complications and the outcome of the patients were monitored. The severity of the disease was calculated using MELD score and Child Pugh Score. Ascites was classified in to three grades: Grade I- presence on examination not clear, but observed in imaging; Grade II- easily made out examination and palpation; Grade III- severe abdominal

distension requiring large volume paracentesis. Hepatic Encephalopathy was graded using West Haven Criteria.

INCLUSION CRITERIA:

All patients with Decompensated Chronic Liver Disease diagnosed by examination, laboratory investigations and radiological imaging.

EXCLUSION CRITERIA:

1. Patients with cardiac failure
2. Patients with chronic kidney disease
3. Patients on drugs such as SSRIs, TCA, MAO inhibitors, cytotoxic drugs etc.,

STATISTICS:

The collected data were entered in a Microsoft Excel Sheet. Graphs and tables were generated using Microsoft Word and Microsoft Excel. Statistical analysis were done using medcalc 15.8, Minitab 17, IBM SPSS 22. Quantitative data was analysed using Mean, Median, Mode and Standard Deviation(SD). Qualitative data was analysed using Chi Square Test, One way ANOVA and Fisher's test. Difference between two variables is considered significant when 'p' value is less than 0.05.

RESULTS

Data were collected from 97 patients admitted in our hospital. The mean age of the patients was 49.69 years with a range of 28-70 years. Out of the 97 patients, 91(93.81%) were males and 6(6.19%) were females. Table 15 shows the demographic details and causes of DCLD.

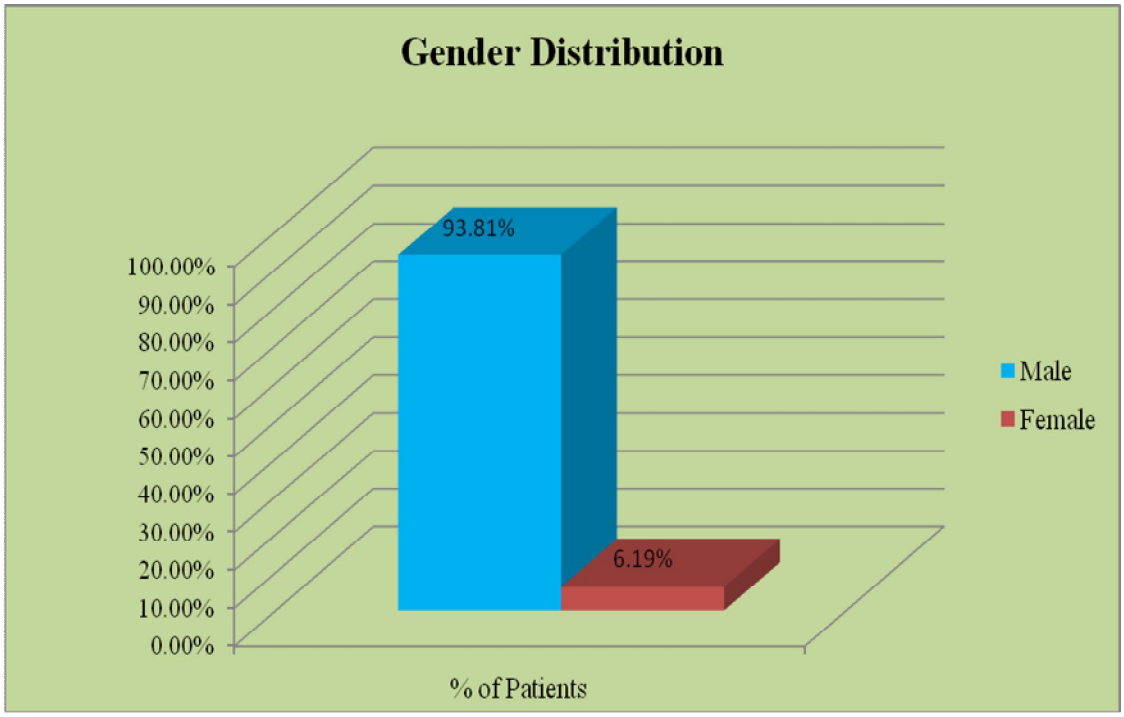
TABLE 15: DEMOGRAPHY DETAILS

Sl.No	Parameter	No Of Patients	% Of Patients	Mean	SD
1.	Age	97		49.69	10.26
2.	Gender				
	Male	91	93.81%		
	Female	6	6.19%		
3.	Cause of cirrhosis				
	Alcohol	89	91.75%		
	HBV	7	7.22%		
	HCV	1	1.03%		
	Other	0	0.00%		
4.	MELD score			13.54	5.50
5.	Serum sodium			134.18	5.02
	1) ≤130 meq/L	23	23.71%		
	2) 131-135 meq/L	32	32.99%		
	3) ≥136 meq/L	42	43.30%		
	4)>145	0	0%		

Alcoholic liver disease was the commonest cause of DCLD in this study accounting for 91.75% while chronic hepatitis B and hepatitis C was found to be the causative factor in 7.22% and 1.03% respectively. The mean concentration of sodium of all patients was 134.18 with a range of 120-144. Based on the serum sodium levels, 23.71% of patients had serum sodium levels less than or equal to 130. 32.99% of patients had serum sodium levels between 131 and 135, while 43.3% of patients had serum sodium levels ≥136. No patients presented with serum sodium greater than 145. The mean MELD score was found to be 13.54 with a range of 7.5- 33.7 .

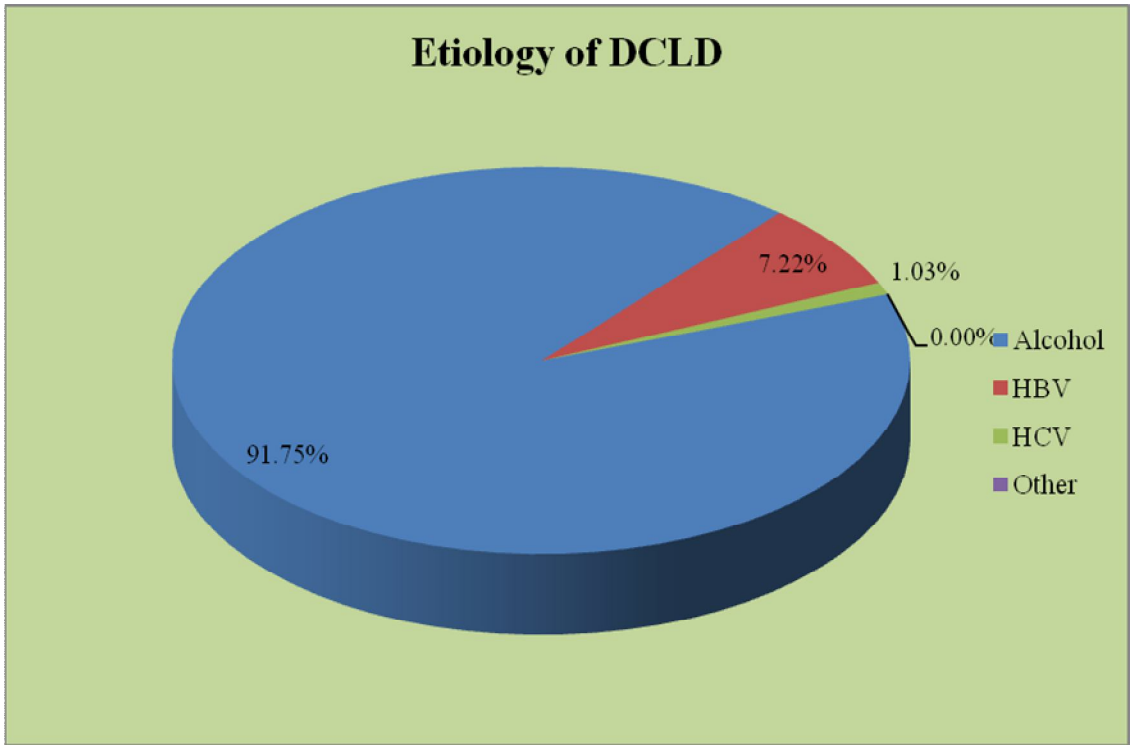
Ratio of male and female in this study was 15.2:1.

FIGURE 15: BAR DIAGRAM SHOWING GENDER DISTRIBUTION



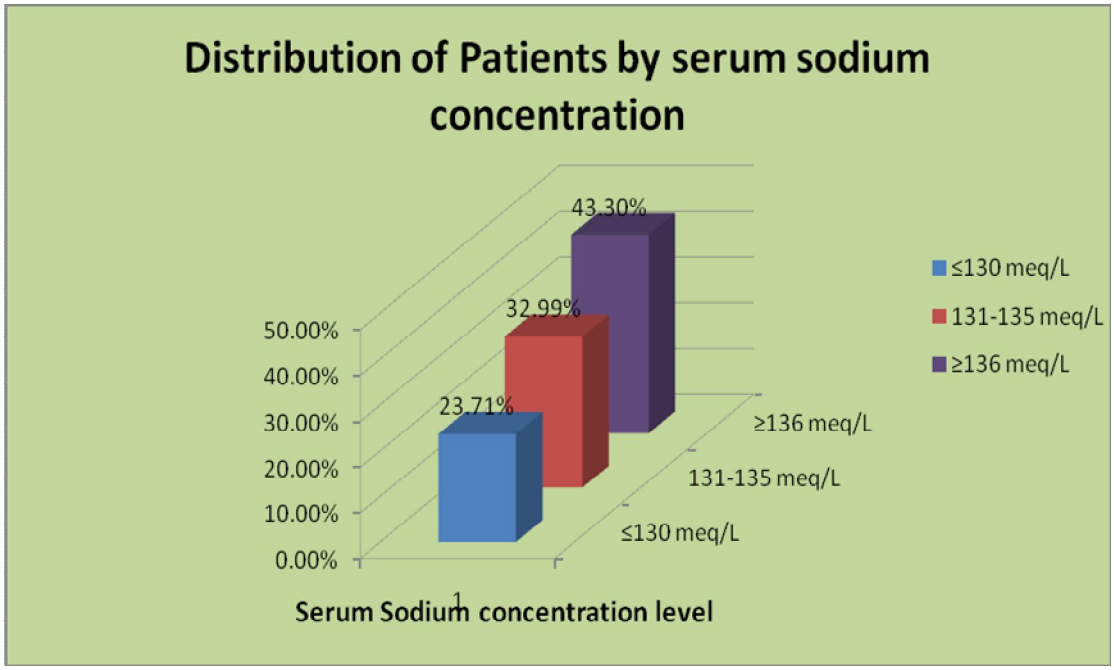
Alcohol was the most common cause of DCLD in this study followed by chronic hepatitis B and chronic hepatitis C.

FIGURE 16: PIE CHART SHOWING ETIOLOGY OF DCLD



43.3% of patients had serum sodium levels ≥136. 32.99% of patients had serum sodium levels between 131 and 135 while 23.71% of patients had serum sodium levels less than or equal to 130.(Figure 16)

FIGURE 17: BAR DIAGRAM SHOWING DISTRIBUTION OF PATIENTS BY SERUM SODIUM CONCENTRATION



Patients were classified into three groups based on the serum sodium level to assess the association between serum sodium levels and patient characteristics, complications and severity of disease as calculated by MELD score and CPS. Those with serum sodium levels less than or equal to 130 formed one group while those with serum sodium levels between 131-135 and those with ≥136 were the other two groups. Mean age of patients with sodium levels ≤130 was 50.50±11.08, while in those with serum sodium levels 131-135 and ≥136 were 49.11±11.49 and 50.82±10.67 respectively. No statistical difference was found among the three groups. (p value - 0.877).

TABLE 16: CHARACTERISTICS OF PATIENTS ACCORDING TO SERUM SODIUM CONCENTRATION

Sl No	PARAMETERS	≤130 meq/L N=23	131-135 meq/L N=32	≥136 meq/L N=42	P value
1	Age(years) (Mean +SD)	50.50±11.08	49.11 ±11.49	50.82±10.67	0.877*
2	SEX: Male Female	 22 1	 31 1	 38 4	 0.479$
3	CAUSE OF DCLD: Alcohol HBV HCV Others	 20 3 0 0	 31 1 0 0	 38 3 1 0	 0.376$
4	MELD score (Mean ±SD)	18.89±6.70	13.17±4.40	10.90±2.95	<0.0001*
5	Child-Pugh Score	10.00 ±1.86	8.53±1.27	7.48 ±1.33	<0.0001*
6	Child Pugh Class Class A Class B Class C	 0 11 12	 1 24 7	 9 29 4	 <0.0001$

*- calculated using one way annova; $- calculated using chi square test.

Serum sodium levels had a strong association with severity of disease as calculated by Child Pugh Class. Among those with serum sodium levels ≤130, 11 belonged to class B and 12 belonged to class C. Among patients with serum sodium levels between 131-135, 1 belonged to class A, 24 belonged to class B

and 7 belonged to class C. Among patients with serum sodium levels ≥136, 9 belonged to class A, 29 belonged to class B and 4 belonged to class C.(p value <0.0001)

Patients with serum sodium levels ≤130 had a mean MELD score of 18.89±6.70, while those with levels between 131-135 and ≥136 had mean scores of 13.17±4.40 and 10.90±2.95 respectively. The difference in MELD scores among the three groups was statistically significant. (p value <0.0001)

No statistical difference was found among the three groups with respect to gender and causative factor.(p value – 0.479, 0.376 respectively). Figure 17 shows the gender distribution among the three groups.

FIGURE 18: BAR DIAGRAM SHOWING GENDER DISTRIBUTION ACCORDING TO SERUM SODIUM CONCENTRATION

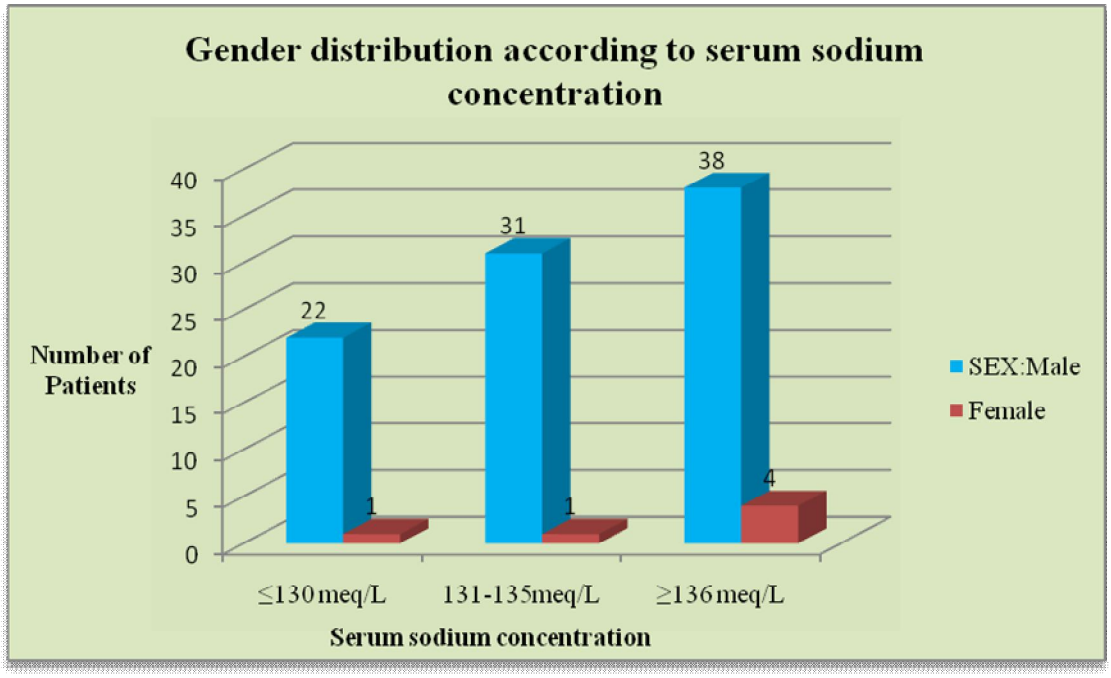
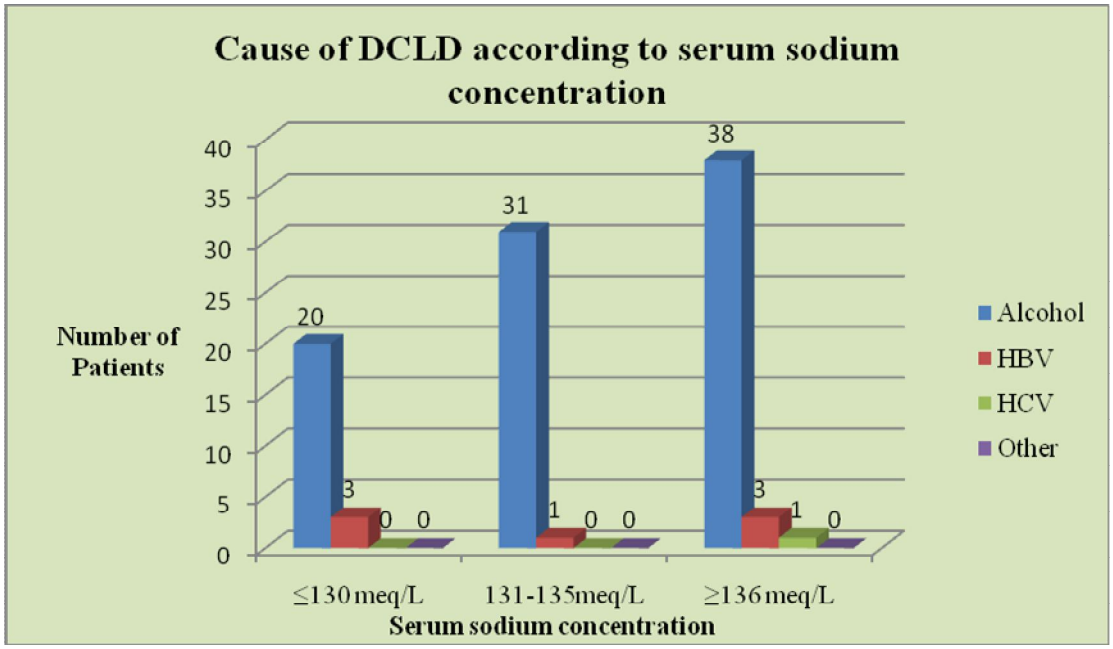


FIGURE 19: BAR DIAGRAM SHOWING CAUSE OF DCLD ACCORDING TO SERUM SODIUM CONCENTRATION



Alcohol remains the common cause of DCLD among the three groups followed by chronic hepatitis B as shown in Figure 18.

TABLE 17: CLINICAL PRESENTATION OF PATIENTS AT THE TIME OF ADMISSION

SL. NO.	CLINICAL PRESENTATION	NUMBER Of PATIENTS	% Of PATIENTS
1	Abdominal Distension	97	100.00%
2	Lower Limb Swelling	97	100.00%
3	Jaundice	29	29.90%
4	Altered Sensorium	14	14.43%
5	Gastrointestinal Bleeding	19	19.59%

All patients presented with abdominal distension and lower limb swelling at the time of admission, while clinically detectable jaundice was found in around 30% of patients. Around 20% of patients presented with GI bleeding while 14 patients presented with history of altered sensorium.

Figure 19 shows the clinical presentation of patients at the time of admission. Abdominal distension and lower limb swelling were the most common presenting complaints followed by jaundice, GI bleeding and altered sensorium.

FIGURE 20: BAR DIAGRAM SHOWING CLINICAL PRESENTATION OF PATIENTS

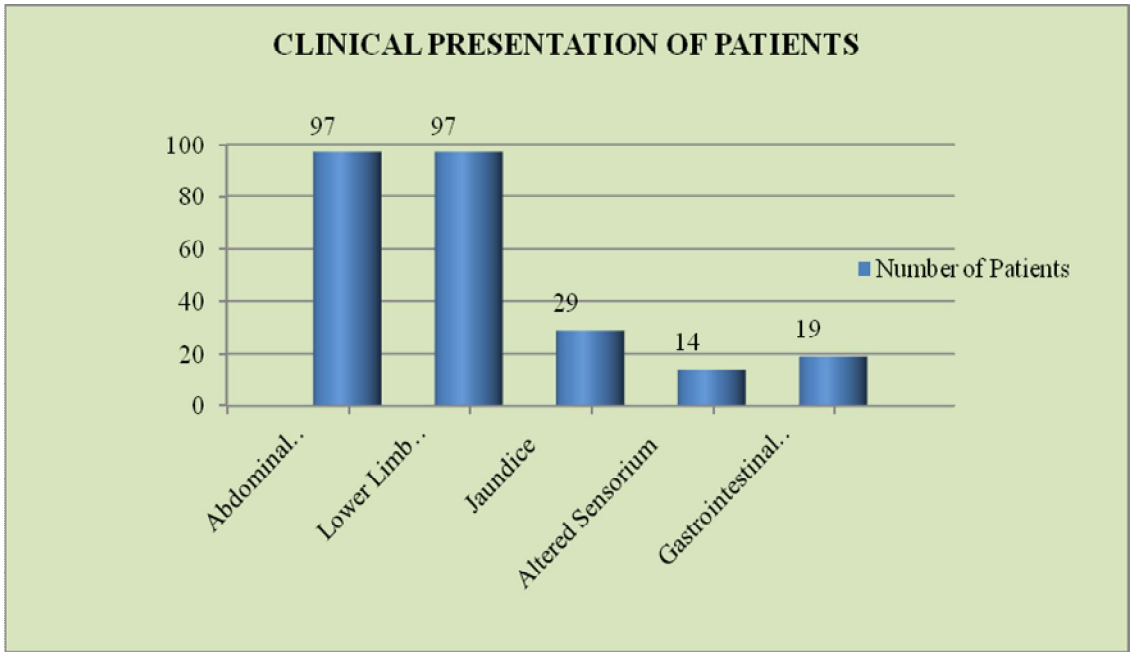


TABLE 18: FREQUENCY OF COMPLICATIONS

SL NO	COMPLICATIONS	NUMBER OF PATIENTS	% OF PATIENTS
1	Ascites	97	100.00%
2	Portal Hypertension	92	94.85%
3	Hepatic Encephalopathy	17	17.53%
4	GI Bleeding	19	19.59%
5	Coagulopathy	12	12.37%
6	Hepatorenal Syndrome	11	11.34%
7	SBP	12	12.37%

Among the 97 patients, Ascites was present in all the patients while portal hypertension was present in around 95% of patients. Hepatic encephalopathy was present in 17.53% while GI bleeding was found in 19.59% of patients. Coagulopathy and SBP were found in 12.37% patients, while hepatorenal syndrome was found in 11.34%.

In the present study, Ascites was the most common complication while hepatorenal syndrome is the least, as shown in the figure 20.

FIGURE 21: BAR DIAGRAM SHOWING DISTRIBUTION OF COMPLICATIONS

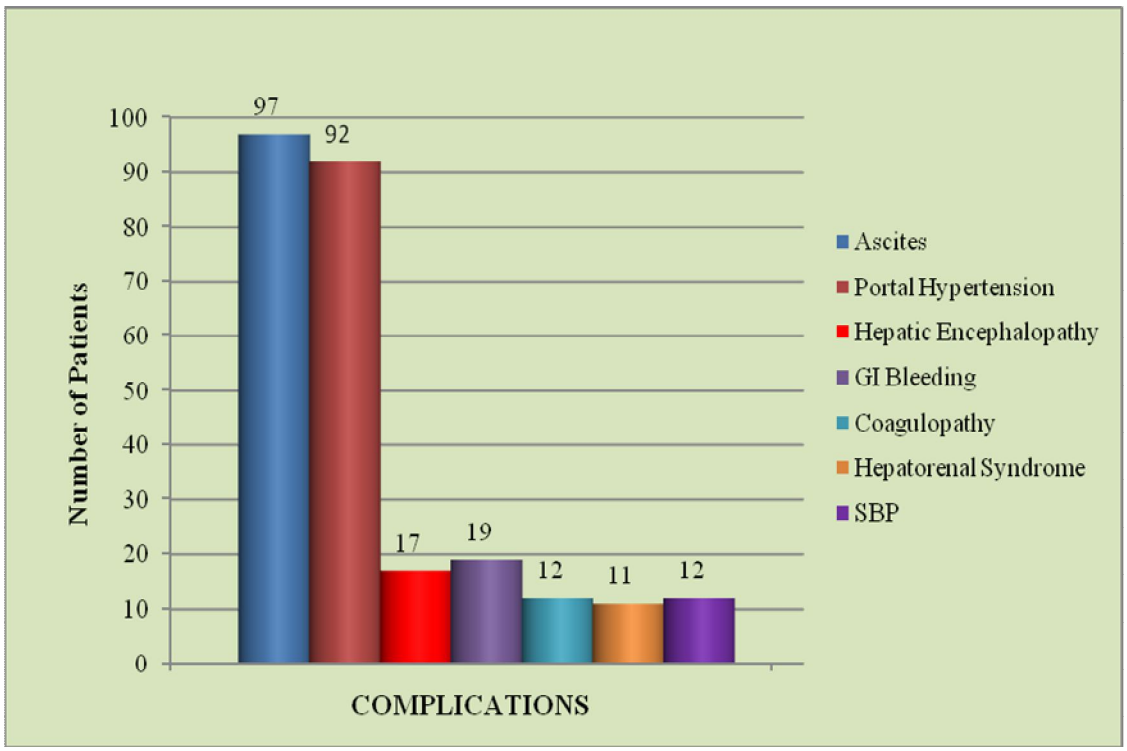


TABLE 19: FREQUENCY OF COMPLICATIONS BY SERUM SODIUM CONCENTRATION

Sl No.	COMPLICATIONS	≤130 meq/L Number (%)	131-135meq/L Number(%)	≥136 meq/L Number (%)	p value*
1	Ascites	23(100%)	32(100%)	42(100%)	0.51
2	Portal Hypertension	23(100%)	32(100%)	37(88.10%)	0.031
3	Hepatic Encephalopathy	13(56.52%)	4(12.50%)	0(0%)	<0.0001
4	GI Bleeding	9(39.13%)	7(21.88%)	3(7.14%)	0.0074
5	Coagulopathy	7(30.43%)	2(6.25%)	3(7.14%)	0.0106
6	Hepatorenal Syndrome	11(47.83%)	0(0%)	0(0%)	<0.0001
7	SBP	8(34.78%)	4(12.50%)	0(0%)	0.0002

*- calculated by chi square test.

There was significant difference in the occurence of complications of DCLD such as Portal Hypertension (p value- 0.031), Hepatic Encephalopathy(p value <0.0001), GI Bleeding(p valuve- 0.0074), coagulopathy(p value- 0.0106), hepatorenal syndrome(p value<0.0001), SBP(p value- 0.0002)among the three groups. There was no significant difference in the presence of ascites among the three groups(p value- 0.51)

Figure 21 shows the increased occurrence of complications in patients with lower serum sodium levels.

FIGURE 22: FREQUENCY OF COMPLICATIONS ACCORDING TO SERUM SODIUM CONCENTRATION

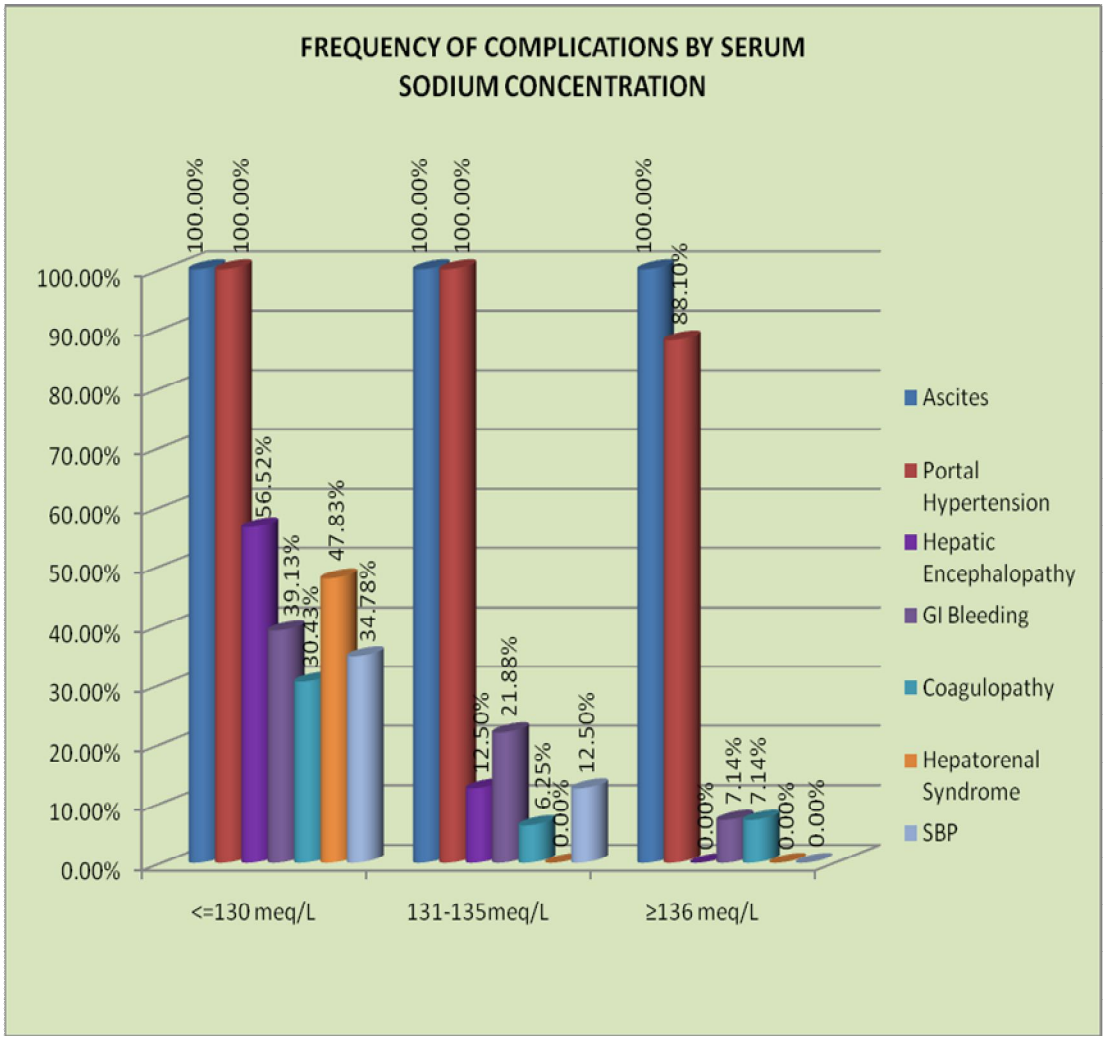


TABLE 20: COMPARISION OF COMPLICATIONS ACCORDING TO SERUM SODIUM CONCENTRATION

Sl No	COMPLICATION	≤130 meq/L N=23 ODDS RATIO (95%CI)	P Value*	131-135meq/L N=32 ODDS RATIO (95% CI)	P value*
1	**Ascites**	0.5529 (0.0106 to 28.7818)	1	0.7647 (0.0148 to 39.5772)	1
2	**Portal Hypertension**	6.8933 (0.3642 to 130.4817)	0.152	9.5333 (0.5075 to 179.068)	0.0653
3	**Hepatic Encephalopathy**	109.2857 (5.9987 to 1990.979)	<0.0001	13.4211 (0.6954 to 259.0198)	0.0312
4	**GI Bleeding**	8.3571 (1.9755 to 35.3548)	0.0026	3.6400 (0.8601 to 15.4055)	0.0900
5	**Coagulopathy**	5.6875 (1.3046 to 24.7955)	0.0265	0.8667 (0.1361 to 5.5199)	1
6	**Hepatorenal Syndrome**	78.2000 (4.2991 to 1422.437)	<0.0001	1.3077 (0.0253 to 67.6793)	1
7	**SBP**	46.6129 (2.5370 to 856.4415)	<0.0001	1.3077 (0.0253 to 67.6793)	0.0312

*- calculated by fisher's test.

When compared to patients with serum sodium levels ≥136, patients with serum sodium levels ≤130 had a significantly increased risk for complications: 109.29 for Hepatic Encephalopathy(p value <0.0001), 8.36 for GI bleeding(p value = 0.0026), 5.69 for Coagulopathy(p value = 0.0265), 78.2 for Hepatorenal syndrome(p value <0.0001) and 46.61 for SBP(p value

<0.0001). Ascites and portal hypertension did not have statistical difference and increased risk.(p value – 1, 0.152 respectively)

When compared to patients with serum sodium levels ≥136, patients with serum sodium levels between 131 and 135 had a significantly increased risk for complications: 13.42 for Hepatic Encephalopathy(p value- 0.0312); 1.3077 for SBP (p value- 0.0312). Other complications did not have statistical difference among the two groups.

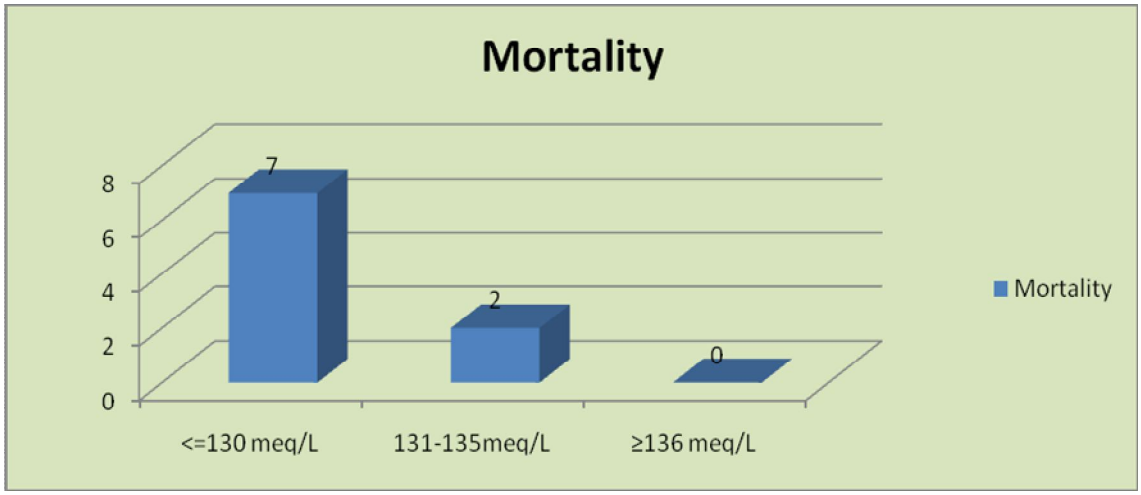
TABLE 21: MORTALITY ACCORDING TO SERUM SODIUM CONCENTRATION

	≤130 meq/L(N=23)	**131-135 meq/L(N=32)**	**≥136 meq/L(N=42)**	**P value**
Mortality	7(30.4%)	2(6.25%)	0(0%)	0.0002

Among 23 patients with serum sodium levels ≤130, 7 patients(30.4%) died. Among 32 patients with serum sodium levels between 131 and 135, 2 patients(6.25%) died. There were no deaths among patients with sodium levels ≥136. The difference in mortality among these three groups was statistically significant. (p value- 0.0002)

Figure 22 shows that mortality increases as serum sodium levels decreases.

FIGURE 23: MORTALITY ACCORDING TO SERUM SODIUM CONCENTRATION



DISCUSSION

A significant proportion of patients with DCLD have abnormal serum sodium concentration. Hyponatremia is the most common occurrence in our study. No patients presented with serum sodium levels greater than 145.

56.7% of patients had serum sodium levels less than 135, while 23.71% patients had serum sodium levels than 130. Serum sodium levels less than 120 were uncommon.

TABLE 22: COMPARISON OF VARIOUS STUDIES SHOWING DISTRIBUTION OF PATIENTS ACCORDING TO SERUM SODIUM LEVELS

STUDIES	DISTRIBUTION OF PATIENTS		
	≤130 mEq/L	131-135 mEq/L	≥136 mEq/L
PRESENT STUDY	23.71%	32.99%	43.3%
ANGELI P ET AL	21.6%	27.8%	50.6%
JONG HOON KIM ET AL	27.1%	20.8%	52.1%
SHAIKH ET AL	26.7%	24.9%	48.4%
BORRONI ET AL	29.8%		

Angeli P et al[8] collected data of 997 cirrhosis patients from 28 hepatology departments across Europe, Asia, North America and South America. Her study revealed that 50.6% patients had normal serum sodium levels, 27.8% patients had sodium levels between 131-135 mEq/L and 21.6% patients had serum sodium levels less than or equal to 130 mEq/L.

Jong Hoon Kim et al[63] analyzed 188 patients admitted in Ilsan paik hospital, Korea with complications of cirrhosis and found that 52.1% patients had normal serum sodium levels, while 20.8% patients had serum sodium levels between 131 and 135. 27.1% patients had serum sodium levels less than or equal to 130.

Shaikh et al[64] studied 217 patients with cirrhosis and found that 48.4% patients had serum sodium levels more than 135 mEq/L, while 24.9% patients had serum sodium levels between 131-135 mEq/L. 26.7% patients had serum sodium levels less than or equal to 130 mEq/L.

Borroni et al[59] studied 156 patients admitted with cirrhosis and found that 29.8% patients had serum sodium levels less than or equal to 130 mEq/L.

The results of the present study extend the observations made by the above mentioned studies that decompensated liver disease is associated with abnormal serum sodium concentration. It also shows that hyponatremia is the common abnormality with more than half of the patients having serum sodium levels less than 135 mEq/L.

Various studies have established that lower sodium levels were associated with ascites that are difficult to manage with diuretics and requiring frequent large volume paracentesis. Arroyo et al noted that patients having serum sodium less than 130 mEq/L had a relatively low GFR and subsequently decreased free water clearance. These patients responded poorly to diuretics when compared with those who had sodium levels more than 130 mEq/L. Angeli P et al and Bernardi et al[65] also found that poorer response to diuretics was associated with lower serum sodium concentration compared to patients who showed response to diuretics. The present study also found that patients with lower sodium levels had higher grade of ascites.

Angeli P et al found that 38% of patients who had serum sodium levels less than or equal to 130 mEq/L had Hepatic Encephalopathy compared to 24% with serum sodium levels between131 and 135 mEq/L.

Jong Hoon Kim et al found that 43.1% of patients with serum sodium levels less than or equal to 130 mEq/L developed hepatic encephalopathy compared to 35.8% with serum sodium levels between 131 and 135 mEq/L.

Shaikh et al found that 25.8% of patients who had serum sodium levels less than or equal to 130 mEq/L developed hepatic encephalopathy.

TABLE 23: COMPARISION OF STUDIES SHOWING ASSOCIATION BETWEEN SERUM SODIUM CONCENTRATION AND HEPATIC ENCEPHALOPATHY.

STUDIES	FREQUENCY OF HEPATIC ENCEPHALOPATHY		
	≤130 mEq/L	131-135 mEq/L	≥136 mEq/L
PRESENT STUDY	56.52%	12.50%	0.00%
ANGELI P ET AL	38%	24%	15%
JONG HOON KIM ET AL	43.1%	35.8%	24.4%
SHAIKH ET AL	25.8%		

In the present study, patients with serum sodium levels ≤130 mEq/L had increased frequency of hepatic encephalopathy compared to the other two groups.

Angeli P et al found that 17% of patients with serum sodium levels ≤130 mEq/L had hepatorenal syndrome compared to 10% and 6% in patients with serum sodium levels 131-135 mEq/L and more than 135 mEq/L respectively.

Jong Hoon Kim et al reported that that 3.9% of patients with serum sodium levels ≤130 mEq/L had hepatorenal syndrome compared to 2.5% and 3% in patients with serum sodium levels 131-135 mEq/L and more than 135 mEq/L respectively.

TABLE 24: COMPARISION OF STUDIES SHOWING ASSOCIATION BETWEEN SERUM SODIUM CONCENTRATION AND HEPATORENAL SYNDROME.

STUDIES	FREQUENCY OF HEPATORENAL SYNDROME		
	≤130 mEq/L	131-135 mEq/L	≥136 mEq/L
PRESENT STUDY	47.83%	0%	0%
ANGELI P ET AL	17%	10%	6%
JONG HOON KIM ET AL	3.9%	2.5%	3%

In present study, patients with serum sodium levels less than or equal to 130 mEq/L had increased frequency of hepatorenal syndrome compared to other two groups.

Angeli P et al found that low sodium level was associated with increased frequency of spontaneous bacterial peritonitis.

Jong Hoon Kim et al reported that that 33.3% of patients with serum sodium levels ≤130 mEq/L had SBP compared to 30.7% and 16.3% in patients with serum sodium levels 131-135 mEq/L and ≥136 mEq/L respectively.

The present study also lends support to the above observations. 34.78% of patients with serum sodium levels ≤130 mEq/L had SBP compared to 12.5% of patients with serum sodium levels between 131-135 mEq/L.

TABLE 25: COMPARISION OF STUDIES SHOWING ASSOCIATION BETWEEN SERUM SODIUM CONCENTRATION AND SBP

STUDIES	FREQUENCY OF SBP		
	≤130 mEq/L	131-135 mEq/L	≥136 mEq/L
PRESENT STUDY	34.78%	12.5%	0%
JONG HOON KIM ET AL	33.3%	30.7%	16.3%

Angeli P et al, Jong Hoon Kim et al and Shaikh et al found no association between GI bleeding and sodium levels. The present study showed increased frequency of GI bleeding in patients with low sodium levels.

Sanford E.Warren et al reported that 15 out of 25 patients with decompensated liver disease had hypernatremia in their study. The present study had no patients with serum sodium levels more than 145 mEq/L.

Jong Hoon Kim et al found that lower sodium levels were associated with increased MELD score and Child Pugh score. This indicates that lower serum sodium levels were associated with severe disease.

The present study also showed that patients with sodium levels ≤130 mEq/L had higher MELD score and Child Pugh Score compared to other two groups.

TABLE 26: COMPARISION OF STUDIES SHOWING ASSOCIATION BETWEEN SERUM SODIUM CONCENTRATION AND MELD SCORE

STUDIES	MELD SCORE		
	≤130 mEq/L	**131-135 mEq/L**	**≥136 mEq/L**
PRESENT STUDY	18.89±6.70	13.17±4.40	10.90±2.95
JONG HOON KIM ET AL	17.20±5.10	16.30±5.20	13.90± 4.60

TABLE 27: COMPARISION OF STUDIES SHOWING ASSOCIATION BETWEEN SERUM SODIUM CONCENTRATION AND CPS

STUDIES	CHILD PUGH SCORE(CPS)		
	≤130 mEq/L	**131-135 mEq/L**	**≥136 mEq/L**
PRESENT STUDY	10.00 ±1.86	8.53±1.27	7.48 ±1.33
JONG HOON KIM ET AL	10.50±1.60	9.80±1.70	8.10± 1.60

The present study also shows increased mortality among patients with lower sodium levels.

TABLE 28: MORTALITY AND SERUM SODIUM

SERUM SODIUM	MORTALITY
≤130 mEq/L	30.4%
131-135 mEq/L	6.25%
≥136 mEq/L	0%

SUMMARY OF RESULTS

- The study was conducted on 97 patients admitted with DCLD in medical wards in Government Vellore Medical College.
- Alcohol is the most common etiology of DCLD in this study followed by Hepatitis B.
- Hyponatremia is the most common sodium abnormality(56.7%). No patients presented with hypernatremia.
- Patients were divided into three groups based on serum sodium; those with serum sodium levels ≥136 mEq/L comprised one group while those with 131-135 mEq/L and ≤130 mEq/L formed the other two groups.
- Serum sodium level was not associated with gender or etiology of DCLD.
- There was significant difference in occurrence of complications such as Portal Hypertension(p value – 0.031), Hepatic Encephalopathy(p value <0.0001), Hepatorenal Syndrome(p value <0.0001), Spontaneous Bacterial Peritonitis(p value-0.0002), Coagulopathy(p value- 0.0106). Increased frequency of complications was noted among patients with lower serum sodium levels.
- There was significant difference in severity scores such as MELD and CPS among the three groups.
- There was significant difference in mortality among the three groups(p value-0.0002). Patients with lower sodium levels had increased mortality.

CONCLUSION

Decompensated Chronic Liver Disease is associated with abnormal serum sodium concentration. Hyponatremia is the most common abnormality in this study. Age, gender and cause of DCLD did not have any association with serum sodium levels. Serum sodium levels less than 135 mEq/L is associated with increased frequency of complications such as Hepatic Encephalopathy, Hepatorenal Syndrome, Spontaneous Bacterial Peritonitis and GI Bleeding when compared to patients with serum sodium levels ≥136 mEq/L. Patients with serum sodium concentration less than 130 mEq/L are the most affected. Lower serum sodium levels are associated with increased MELD score, increased CPS score and increased mortality indicating the inverse relationship between serum sodium levels and the severity of disease. Thus patients with decreased serum sodium levels should be considered a high risk population because of the increased frequency of complications and mortality.

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PROFORMA

A STUDY OF SERUM SODIUM LEVELS IN DECOMPENSATED CHRONIC LIVER DISEASE AND ITS CLINICAL CORRELATION

Name: Age /sex:

Occupation: Date of enrollment:

Address:

Contact no:

Presenting complaints:	Yes	No
Abdominal distension		
Lower limb swelling		
Jaundice		
Bleeding (hematemesis/malena)		
Fever		
Abdominal pain		
Oliguria		
Altered sensorium		
Others		

Past history:

H/o Jaundice Previous Treatment

Personal history:

Alcohol: Smoking: Family H/o:

General physical examination:

Pulse: BP:

RR: Temp:

Pallor Icterus Edema

Clubbing Cyanosis

Lymphadenopathy

S/o liver cell failure:

Alopecia	
Asterixis (Flaps)	
Atrophy of The Testis	
Bitot's Spot	
Bleeding Tendencies	
Dupuytren's Contracture	
Jaundice	
Fruity Odour	
Foetor Hepaticus	
Gynaecomastia	
Loss of Buccal Pad of Fat	
Loss of Secondary Sexual Characters	
Parotid Enlargement	
Palmar Erythema	
Pedal Edema	
Pruritis	
Spider Naevi	

Systemic examination:

ABDOMEN:

Ascites Liver / spleen Bowel sounds

RS: Added sounds

CVS: S1 S2 MURMUR

CNS: Sensorium

Asterixis

Investigations:

HB	WBC	PLATELET
RBS	UREA	CREATININE
TB/DB	TP/ALB	AST/ALT
PT/INR	HBsAG	HCV

ASCITIC FLUID ANALYSIS:

CELL COUNT	PROTEIN/ SUGAR	CULTURE AND SENSITIVITY

USG ABDOMEN:

LIVER	ASCITES	PORTAL VEIN	KIDNEY

SERUM ELECTROLYTES:

	AT THE TIME OF ADMISSION	OUTCOME
SERUM SODIUM		
COMPLICATIONS		

UGI SCOPY:

CHILD PUGH SCORE AND CLASS: MELD SCORE:

பங்கேற்பவர்களுக்கு ஆய்வின் விவரம்

ஆய்வின் நோக்கம்

ஈட்டுத்திறனிழந்த கல்லீரல் நோயால் பாதிக்கப்பட்டவர்களின் இரத்தத்தில் சோடியம் உப்பின் அளவும் அதன் மருத்துவ முக்கியத்துவமும் பற்றி ஆராயுதல்

ஆய்வில் பங்கேற்பதற்கான தகுதிகள்

முழு பரிசோதனைக்குப்பின் ஈட்டுத்திறனிழந்த கல்லீரல் நோயுள்ளவர்கள் என்று கண்டறியப்பட்டவர்கள்.

செய்முறை விளக்கம்

இந்த ஆய்வில் பங்கேற்பவர்களுக்கு முழு உடல் பரிசோதனை செய்து நோயின் அறிகுறிகள் கண்டறியப்படும்.

கல்லீரல் நோய் சம்பந்தப்பட்ட இரத்த பரிசோதனை மற்றும் வயிற்றில் சேரக்கூடிய நீரின் பரிசோதனை செய்யப்படும். மேலும் வயிறு ஸ்கேன் எடுக்கப்படும்.

உடற்பரிசோதனையினால் எந்த பக்க விளைவுகளும் நேராது. இரத்தப் பரிசோதனையினால் சிறு வலி மற்றும் இரத்தக்கசிவு நேரிடலாம். இதனால் எவ்வித பாதிப்பும் ஏற்படாது. ஸ்கேன் எடுப்பதால் எந்த கதிர் வீச்சு பாதிப்பும் ஏற்படாது.

ஏன் பங்கேற்க வேண்டும்

ஈட்டுத்திறனிழந்த கல்லீரல் நோயின் விளைவுகளுக்கும் சோடியம் உப்பின் அளவிற்கும் சம்பந்தம் இருப்பின் நோயின் வீரியம் மற்றும் முடிவுத்தன்மை குறித்து அறியலாம்.

ஆராய்ச்சி நிலையம்

பொது மருத்துவ துறை

அரசு வேலூர் மருத்துவ கல்லூரி மற்றும் மருத்துவமனை

வேலூர்

ஆய்வாளரின் பெயர் : இரா.அருண் நடேஷ்

வழிகாட்டி: பேராசிரியர். மரு. ஜே.பிலோமினா

சுய ஒப்புதல் படிவம்

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. என்னுடைய சந்தேகங்களை கேட்கவும், அதற்கான விளக்கங்களை பெறவும் வாய்ப்பளிக்கப்பட்டது.

நான் இவ்வாய்வில் தன்னிச்சையாகத்தான் பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த கட்டத்திலும் சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகி கொள்ளலாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொண்டேன். நான் ஆய்வில் இருந்து விலகி கொண்டாலும் இது பொருந்தும் என அறிகிறேன்.

இந்த ஆய்வின் மூலம் கிடைக்கும் தகவல்களையும் பரிசோதனை முடிவுகளையும் மற்றும் சிகிச்சை தொடர்பான தகவல்களையும் மருத்துவர் மேற்கொள்ளும் ஆய்வில் பயன்படுத்தி கொள்ளவும் அதை பிரசுரிக்கவும் என் முழு மனதுடன் சம்மதிக்கிறேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். எனக்கு கொடுக்கப்பட்ட அறிவுரைகளின்படி நடந்து கொள்வதுடன் இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன். என் உடல் நலம் பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத வழக்கத்திற்கு மாறான நோய்குறி தென்பட்டாலோ உடனே அதை மருத்துவ அணியிடம் தெரிவிப்பேன் என உறுதியளிக்கிறேன்.

இடம் ..... பங்கேற்பவரின் கையொப்பம் .....

நாள் ..... கட்டைவிரல் ரேகை

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் .....

.....

இடம் ..... ஆய்வாளரின் கையொப்பம் .....

நாள் ..... ஆய்வாளரின் பெயர் : இரா.அருண் நடேஷ்

MASTER CHART

S.N.	NAME	A	S	AD	LS	JAU	ASN	GIB	ALC	PAL	ICT	CLU	PE	LCF	AS	ORG	AS	PHT	HE	SBP	HRS	GI B	CGP	Ur	Cr	Na	TB/DB	TP/ALB	ALT/AST/ALP	PT/INR	MELD	CPS	CPC	HBSAG	HCV	USG ABD	ENDOSCOPY	OUT
1	KANNAN	46	M	P	P	A	P	A	P	A	A	P	P	P	P	A	G II	P	A	A	A	A	A	32	1.1	131	0.9/0.3	5.9/3.1	38/45/115	15/1.2	9.4	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 11MM	ESO VARICES	D
2	GOVINDASAMY	48	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	A	36	1.2	132	1.0/0.3	5.8/3.4	42/65/134	16/1.2	10.2	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
3	SENTHIL KUMAR	38	M	P	P	P	A	A	P	A	P	A	P	P	P	SPL	G II	P	G I	A	A	A	A	45	1.2	129	3.8/2.4	5.4/3.0	65/72/121	19/1.5	17.8	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
4	RAJA	43	M	P	P	P	A	A	P	A	P	P	P	P	P	A	G II	P	A	A	A	A	A	36	1	132	3.2/1.8	5.2/2.5	47/41/98	18.9/1.5	14	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
5	ELUMALAI	60	M	P	P	A	A	P	P	A	A	P	P	P	P	A	G II	P	A	A	P	P	A	62	1.6	129	1.0/0.3	5.8/3.2	54/66/110	20/1.5	15.5	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
6	VIJAYAKUMAR	57	M	P	P	P	P	P	P	P	P	P	P	P	P	A	G III	P	G II	A	P	P	P	69	1.9	126	4.2/2.4	5.7/3.1	95/120/138	22/1.7	23.9	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
7	RAJAMANICKAM	67	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	0.9	137	1.0/0.3	5.9/3.5	36/42/69	13/1.1	7.5	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
8	RAJKUMAR	41	M	P	P	P	P	P	P	A	P	P	P	P	P	A	G III	P	G II	A	P	P	P	47	2.1	128	4/2.6	5.6/3.1	216/196/140	26/2.0	27	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES, PHG	D
9	SIVALINGAM	63	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	P	A	A	A	62	1.9	129	1.2/0.4	5.6/3.2	45/62/88	16/1.2	15.3	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
10	THANGAVEL	49	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	37	1.1	139	1.0/0.4	5.9/3.6	42/53/62	15/1.2	9.4	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	NORMAL	D
11	KUPPAN	70	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G II	P	A	A	A	A	A	34	0.8	141	0.9/0.4	6.0/3.6	42/48/84	15/1.2	8.5	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
12	VIJAYAN	54	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	33	1.1	136	0.9/0.3	5.9/3.4	62/75/98	15/1.2	9.4	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
13	PARTHIBAN	33	M	P	P	P	A	A	P	A	P	A	P	P	P	A	G II	P	A	A	A	A	A	36	1	136	4.8/3.2	5.7/3.2	84/98/114	17/1.3	15.3	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
14	SELVAM	60	M	P	P	A	A	A	P	A	P	P	P	P	P	A	G III	P	A	A	A	A	A	36	1	130	1.2/0.4	5.9/3.5	54/65/89	16/1.3	10.1	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
15	KHANBADSHA	33	M	P	P	A	A	P	P	P	A	A	P	P	P	A	G II	P	A	A	A	A	A	42	1.3	134	1.2/0.5	5.8/3.2	62/56/78	18/1.4	13.4	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
16	KUMAR	55	M	P	P	A	P	A	P	A	A	P	P	P	P	A	G III	P	G I	A	A	A	A	36	1	130	1.2/0.5	6.0/3.3	56/72/97	15/1.2	9.2	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
17	RAMESH	54	M	P	P	P	A	A	P	A	P	P	P	P	P	A	G III	P	A	P	A	A	A	54	1.5	128	1.2/0.5	5.4/2.9	62/74/108	16/1.3	13.9	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
18	SUBRAMANI	53	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	35	1	138	1.2/0.5	5.8/3.2	54/68/124	15/1.2	9.2	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
19	ELUMALAI	55	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	1	139	0.9/0.4	5.9/3.5	66/76/115	15/1.2	8.5	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
20	SENTHIL	30	M	P	P	P	A	A	P	A	P	A	P	P	P	SPL	G II	P	A	A	A	A	A	46	1.3	132	4.8/3.0	5.8/3.2	92/108/142	18/1.5	19.4	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 15MM	ESO VARICES	D
21	MURUGAN	46	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	36	1	136	1.0/0.3	5.9/3.4	36/52/101	15/1.2	8.5	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 15MM	ESO VARICES, PHG	D
22	PONNAPPAN	50	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	1	138	1.1/0.4	5.9/3.2	62/66/97	15/1.2	8.8	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
23	CHAKKRAVARTHY	51	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	P	A	A	A	65	1.4	129	1.2/0.5	5.4/2.9	78/92/138	16/1.2	12.4	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
24	GOVINDASAMY	50	M	P	P	P	A	A	P	A	P	P	P	P	P	A	G III	P	A	A	A	A	A	28	0.9	133	3.2/1.8	5.8/3.4	62/74/112	18/1.4	14.6	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
25	DHANAPAL	60	M	P	P	A	P	A	P	A	A	P	P	P	P	A	G III	P	G II	A	A	A	A	38	1.2	128	1.0/0.5	5.7/3.2	56/64/89	16/1.2	10.2	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
26	BABU	44	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	A	A	A	A	A	A	38	1	144	0.9/0.3	6.0/3.4	42/56/98	15/1.2	8.5	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	NORMAL	D
27	PARTHASARATHY	68	M	P	P	A	A	A	P	P	A	A	P	P	P	A	G II	P	A	A	A	A	A	39	1	138	0.8/0.3	5.8/3.6	55/72/110	16/1.2	8.5	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
28	KRISHNAN	60	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	38	1	134	1.1/0.4	5.9/3.6	69/82/113	16/1.2	8.8	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
29	RAJA	55	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	39	1.1	138	1.3/0.7	5.8/3.4	71/82/120	16/1.2	10.4	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
30	AFTHAR	40	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	39	1.1	141	1.2/0.4	6.0/3.6	52/65/76	15/1.2	10.1	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
31	PRABHAKARAN	36	M	P	P	P	A	A	P	A	P	A	P	P	P	A	G II	P	A	A	A	A	A	37	0.9	139	4.2/2.6	5.8/3.4	57/61/89	16/1.2	13.9	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
32	ELANGOVAN	42	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	38	1	142	1.2/0.5	5.8/3.3	50/60/83	16/1.2	9.2	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
33	MOHAN	45	M	P	P	P	A	P	P	P	P	P	P	P	P	A	G III	P	A	A	A	P	A	42	1.2	133	3.4/1.8	5.6/3.2	87/92/133	18/1.5	17.3	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
34	JOHN BASHA	60	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	A	24	0.6	134	0.6/0.2	5.7/3.4	36/50/82	18/1.5	11	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 15MM	ESO VARICES	D
35	SELVAM	42	M	P	P	A	A	A	P	A	A	P	P	P	P	SPL	G III	P	A	A	A	A	A	23	0.9	139	1.2/0.6	5.8/3.4	57/63/85	16/1.2	9.2	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 11MM	ESO VARICES	D
36	MURUGESAN	60	M	P	P	A	A	A	A	A	A	A	P	P	P	A	G II	A	A	A	A	A	A	36	1.2	142	0.8/0.2	5.6/3.5	59/67/111	18/1.4	11.9	7	B	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	NORMAL	D
37	MOORTHY	53	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	P	18	0.6	136	1.4/0.7	5.4/3.2	58/43/77	22/1.7	13.6	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
38	GOVINDRAJ	65	M	P	P	P	P	A	A	A	P	P	P	P	P	A	G III	P	G III	P	P	A	A	82	3.4	124	2.7/1.1	5.4/3.1	123/87/114	16/1.2	23.9	12	C	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	E
39	SURESH BABU	35	M	P	P	P	A	P	P	A	A	A	P	P	P	A	G III	P	A	A	A	P	P	40	0.6	134	2.8/1.2	6.5/3.0	66/38/80	21/1.6	15.6	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
40	SELVAM	60	M	P	P	P	A	A	P	A	P	P	P	P	P	A	G II	P	A	A	A	A	A	21	0.7	138	3.8/2.4	5.1/2.8	72/57/92	17/1.3	14.4	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
41	MOORTHY	45	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	38	0.9	136	0.9/0.3	6.2/3.8	60/49/87	16/1.2	8.5	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
42	RADHA	60	F	P	P	A	A	A	A	A	A	A	P	P	P	SPL	G III	P	A	A	A	A	A	18	0.6	144	0.9/0.3	6.0/2.9	46/57/79	16/1.2	8.5	8	B	NEG	POS	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
43	KARTHICK	28	M	P	P	P	P	P	P	P	P	A	P	P	P	A	G III	P	G III	A	P	P	P	73	2.8	126	5.6/4.0	5.2/2.8	112/131/156	21/1.6	28.1	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	E
44	RAVIKUMAR	57	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	A	50	1.3	127	1.2/0.5	5.7/3.3	59/73/89	18/1.4	13.4	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
45	MOORTHY	32	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	38	1.1	139	1.2/0.4	5.8/3.2	58/73/95	16/1.2	10.1	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
46	PALANISAMY	42	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	P	P	A	A	76	2.8	128	1.2/0.6	5.3/3.3	77/85/113	18/1.4	20.7	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
47	BENATIC BOSCHO	60	M	P	P	A	A	P	P	A	A	P	P	P	P	SPL	G II	P	A	A	A	A	A	38	1.1	134	1.4/0.6	5.8/3.3	55/47/74	16/1.2	10.7	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
48	KANTHA	59	F	P	P	P	A	A	A	A	P	A	P	P	P	A	G III	P	A	P	A	A	A	41	1.4	130	3.1/2.5	4.8/1.7	64/32/81	16/1.2	16	11	C	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D

49	CHINNARAJ	70	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	38	1	138	1.2/0.5	5.9/3.5	32/47/59	16/1.2	9.2	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	NORMAL	D
50	CHAKRAVARTHY	50	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	1.1	139	1.1/0.4	6.1/3.5	54/67/96	15/1.2	9.7	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
51	UDAYA KUMAR	38	M	P	P	A	A	P	P	A	A	A	P	P	P	A	G III	P	A	A	A	P	A	38	1	134	1.2/0.5	6.1/3.5	47/65/78	16/1.2	9.2	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
52	MURUGAN	59	M	P	P	A	A	A	P	A	A	A	P	P	P	SPL	G II	P	A	A	A	A	A	39	1.1	138	1.4/0.6	5.9/3.3	61/57/75	17/1.3	11.6	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
53	KARUNANIDHI	62	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	A	41	0.9	134	1.3/0.6	6.0/3.4	51/63/81	16/1.2	9.5	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
54	ARUMUGAM	58	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	A	A	A	A	A	A	38	1.1	139	1.2/0.5	5.9/3.3	66/73/91	17/1.3	11	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	NORMAL	D
55	THANIKACHALAM	50	M	P	P	P	P	P	P	P	P	P	P	P	P	A	G III	P	G III	A	P	P	P	66	2.4	128	4.8/3.0	5.6/3.0	114/108/132	20/1.5	25.3	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	E
56	VASANTHA	57	F	P	P	A	A	A	A	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	40	1.1	140	1.2/0.6	5.9/3.4	58/64/83	16/1.2	10.1	7	B	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
57	GAMALI	45	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	0.9	141	1.1/0.4	6.0/3.6	56/62/78	16/1.2	8.8	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
58	PARTHASARATHY	68	M	P	P	A	A	A	P	A	A	A	P	P	P	SPL	G III	P	A	A	A	A	A	38	1	133	1.0/0.3	5.9/3.5	54/63/86	16/1.2	8.5	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
59	PAZHANI	40	M	P	P	P	P	P	P	P	A	P	P	P	SPL	G III	P	G II	A	A	P	A	36	0.8	129	3.8/2.1	5.8/3.2	84/93/119	18/1.4	15.2	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
60	SIVAKUMAR	37	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	A	A	A	A	A	A	40	1.1	138	1.2/0.5	6.0/3.6	43/55/70	17/1.3	11	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	NORMAL	D
61	LAKSHMI	54	F	P	P	A	A	A	P	P	A	A	P	P	P	A	G II	P	A	A	A	A	A	39	1	137	1.2/0.6	5.9/3.4	51/64/88	17/1.3	10.1	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
62	KODEESWARAN	46	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	P	A	A	A	45	1.2	131	1.3/0.6	5.6/3.3	58/73/91	17/1.3	12.1	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
63	GOPI	65	M	P	P	A	P	P	P	A	A	P	P	P	P	A	G III	P	G II	A	A	P	A	39	1	132	1.3/0.7	5.8/3.5	78/92/113	16/1.2	9.5	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES, PHG	D
64	KAMARAJ	54	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	39	1.1	133	1.0/0.3	5.8/3.2	52/64/87	16/1.2	9.4	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
65	LOKESH	45	M	P	P	A	A	P	A	P	A	A	P	P	P	A	G III	P	A	A	A	P	A	41	1.2	138	1.2/0.5	5.6/3.1	73/87/110	18/1.4	13.4	8	B	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	D
66	VENKATESH	35	M	P	P	P	P	P	P	A	P	A	P	P	P	A	G III	P	G III	A	P	P	P	63	2.1	126	4.6/2.5	5.6/2.9	110/122/132	20/1.5	23.8	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	E
67	JAYABABU	54	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	42	1	140	1.6/0.7	6.2/3.6	43/58/72	17/1.3	11.1	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
68	SUNDHARAMOORTHY	52	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	31	1	141	1.2/0.4	6.1/3.4	36/46/68	16/1.2	9.2	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
69	VADIVELU	37	M	P	P	P	A	P	P	P	P	A	P	P	P	A	G III	P	A	A	A	A	P	42	1	138	5.2/3.2	5.5/3.2	72/62/84	24/1.9	19.9	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
70	MOORTHY	40	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	30	0.9	140	0.9/0.3	6.1/3.8	62/74/88	16/1.2	8.5	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
71	KAMAL	48	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	36	0.9	142	1.4/0.6	5.8/3.4	52/65/82	16/1.2	9.7	6	A	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
72	THASTHAGIR	60	M	P	P	P	P	A	P	A	P	P	P	P	P	A	G III	P	G II	A	A	A	A	41	1.2	130	6.4/4.8	5.5/3.0	88/72/102	16/1.2	17.2	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
73	DEVENDIRAN	35	M	P	P	P	P	P	P	P	P	P	P	P	P	A	G III	P	G III	A	P	P	P	82	3	122	8.1/6.4	5.2/2.8	92/86/110	28/2.2	33.7	13	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	E
74	MOHAN	41	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	P	A	A	A	40	1.2	131	1.2/0.7	5.6/3.1	45/67/82	17/1.3	11.8	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
75	SELVAPERUMAL	33	M	P	P	P	A	A	P	A	P	A	P	P	P	SPL	G II	P	A	A	A	A	A	40	1.1	138	4.8/3.1	6.3/3.4	68/73/82	17/1.3	16.2	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
76	KALAISELVAM	67	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	36	0.9	141	0.9/0.3	6.2/3.7	58/45/63	16/1.2	8.5	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
77	AMMAI	62	F	P	P	P	A	A	P	A	P	A	P	P	P	A	G II	A	A	A	A	A	A	38	1	139	3.8/2.1	5.9/3.4	49/53/70	18/1.4	15.2	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	NORMAL	D
78	VIJAYAN	56	M	P	P	P	P	P	P	A	P	A	P	P	P	A	G II	P	G III	A	A	P	P	62	3.5	132	5.2/3.4	6.0/2.8	98/86/112	26/2.0	30.3	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	E
79	GANESAN	38	M	P	P	P	A	A	P	A	P	A	P	P	P	SPL	G III	P	A	P	A	A	A	49	1.3	132	2.8/2.4	5.7/3.0	66/60/92	17/1.3	16.9	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
80	SURESH	41	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	28	0.8	139	2.4/1.2	6.2/3.6	64/58/96	16/1.2	11.8	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
81	ARUMUGAM	62	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	31	0.9	133	1.2/0.8	6.0/3.4	64/50/98	17/1.3	10.1	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
82	SARAVANAN	48	M	P	P	A	A	P	P	A	A	A	P	P	P	SPL	G II	P	A	A	A	P	A	43	1	138	1.6/0.9	6.1/3.4	58/48/86	17/1.3	11.1	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES, PHG	D
83	LALITHA	50	F	P	P	A	A	A	A	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	32	0.9	134	1.6/0.9	6.0/3.3	55/46/82	16/1.2	10.2	7	B	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
84	RAJENDRAN	45	M	P	P	A	P	P	P	P	A	P	P	P	P	A	G III	P	G III	P	P	P	P	82	3.9	120	2.0/1.2	5.8/2.9	65/56/90	23/1.7	28	12	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES, PHG	E
85	PURUSHOTHAMAN	39	M	P	P	P	A	A	P	A	P	A	P	P	P	A	G II	P	A	A	A	A	A	30	0.8	134	3.0/2.0	6.1/3.2	66/51/83	17/1.3	13.5	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	NORMAL	D
86	PITCHAI	60	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G II	P	A	A	A	A	A	39	1	134	1.9/1.0	6.4/3.4	53/59/69	16/1.2	10.9	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 12MM	ESO VARICES	D
87	MANOHARAN	55	M	P	P	A	A	A	P	A	A	P	P	P	P	A	G III	P	A	A	A	A	A	33	0.9	132	1.8/1.0	6.2/3.4	64/54/88	16/1.2	10.7	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
88	CHANDRAN	43	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	G I	A	A	A	A	36	1.1	131	1.5/0.8	6.4/3.2	59/52/91	18/1.4	12.6	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
89	DURAIRAJ	54	M	P	P	P	A	P	P	A	P	A	P	P	P	A	G III	P	A	P	A	P	A	50	1.2	132	3.1/1.8	5.6/2.9	70/62/89	18/1.4	16.2	10	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
90	JOTHI	42	M	P	P	A	A	A	P	A	A	A	P	P	P	SPL	G III	P	A	A	A	A	A	39	1	133	2.0/1.1	5.9/3.1	58/55/75	20/1.5	13.6	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 14MM	ESO VARICES	D
91	DHARMAN	38	M	P	P	P	A	P	P	A	P	A	P	P	P	A	G II	P	A	A	A	P	P	48	1.2	136	4.3/2.3	6.1/3.0	69/61/95	22/1.7	19.6	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES, PHG	D
92	SETTU	45	M	P	P	P	A	P	P	P	P	P	P	P	P	A	G III	P	G II	A	A	P	A	62	1.5	131	4.8/3.1	6.0/2.9	90/82/116	18/1.4	20	11	C	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES, PHG	E
93	GUNASEKARAN	48	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G III	P	A	A	A	A	A	39	1.1	128	1.8/1.0	5.4/2.8	58/50/88	20/1.5	14.1	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
94	PARASURAMAN	50	M	P	P	A	A	A	P	A	A	A	P	P	P	SPL	G III	P	A	A	A	A	A	44	1.2	131	1.8/0.9	5.9/3.2	64/56/88	19/1.4	14.2	8	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
95	HARIDAS	40	M	P	P	A	A	A	P	A	P	A	P	P	P	A	G II	P	A	A	A	A	A	38	1.1	133	3.4/1.8	5.9/3.0	62/54/90	18/1.4	15.7	9	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
96	MANI	49	M	P	P	A	A	A	P	A	A	A	P	P	P	A	G II	P	A	A	A	A	A	38	1	134	1.6/0.9	6.0/3.1	68/58/86	18/1.4	12	7	B	NEG	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	D
97	RAMESH	41	M	P	P	A	A	A	A	A	A	P	P	P	P	A	G III	P	A	P	P	A	A	69	2.6	128	1.8/1.0	5.6/3.0	78/68/90	16/1.2	19.8	8	B	POS	NEG	COARSE ECHOTEXTURE, LIVER SPAN REDUCED, ASCITES, PV- 13MM	ESO VARICES	E

KEY TO MASTER CHART

S.N. – Serial Number	TB/DB – Total/ Direct Bilirubin
A – Age	ALT – Alanine Transaminase
S – Sex	AST – Aspartate Transaminase
AD – Abdominal Distension	ALP – Alkaline Phosphatase
LS – Leg Swelling	TP/ALB – Total Protein/ Albumin
JAU – Jaundice	PT – Prothrombin Time
ASN – Altered Sensorium	INR – International Normalized Ratio
GIB – Gastro Intestinal Bleeding	MELD – Model for End Stage Liver Disease Score
ALC – Alcohol	CPS – Child Pugh Score
PAL – Pallor	CPC – Child Pugh Class
ICT – Icterus	HBsAg – Hepatitis B Surface Antigen
CLU – Clubbing	HCV – Antibody to Hepatitis C Virus
PE – Pedal Edema	USG ABD – Ultrsonogram Abdomen
LCF – Signs of Liver Cell Failure	O – Outcome
ORG – Organomegaly	D – Discharged
SPL – Spleenomegaly	E – Expired
AS - Ascites	P – Present
PHT – Portal Hypertension	A – Absent
HE – Hepatic Encephalopathy	NEG - Negative
HRS – Hepato Renal Syndrome	POS – Positive
SBP – Spontaneous Bacterial Peritonitis	PV – Portal Vein
CGP – Coagulopathy	G - Grade
Ur – Urea	
Cr – Creatinine	
Na – Serum Sodium	